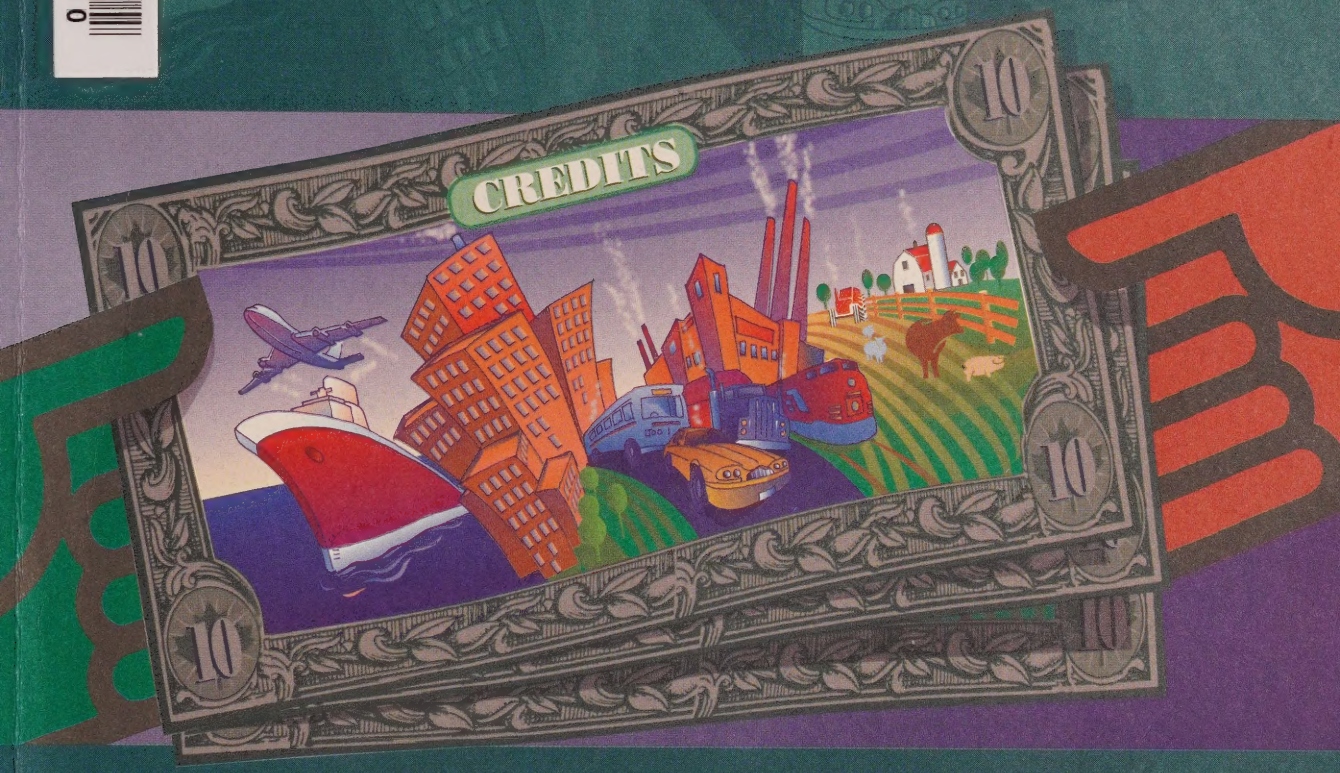
Canada's Options for a Domestic Greenhouse Gas Emissions Trading Program



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National Round Table on the Environment and the Economy
344 Slater Street, Suite 200
Ottawa, Ontario
Canada K1R 7Y3
Tel.: (613) 992-7189
Fax: (613) 992-7385
E-mail: admin@nrtee-trnee.ca
Web: http://www.nrtee-trnee.ca

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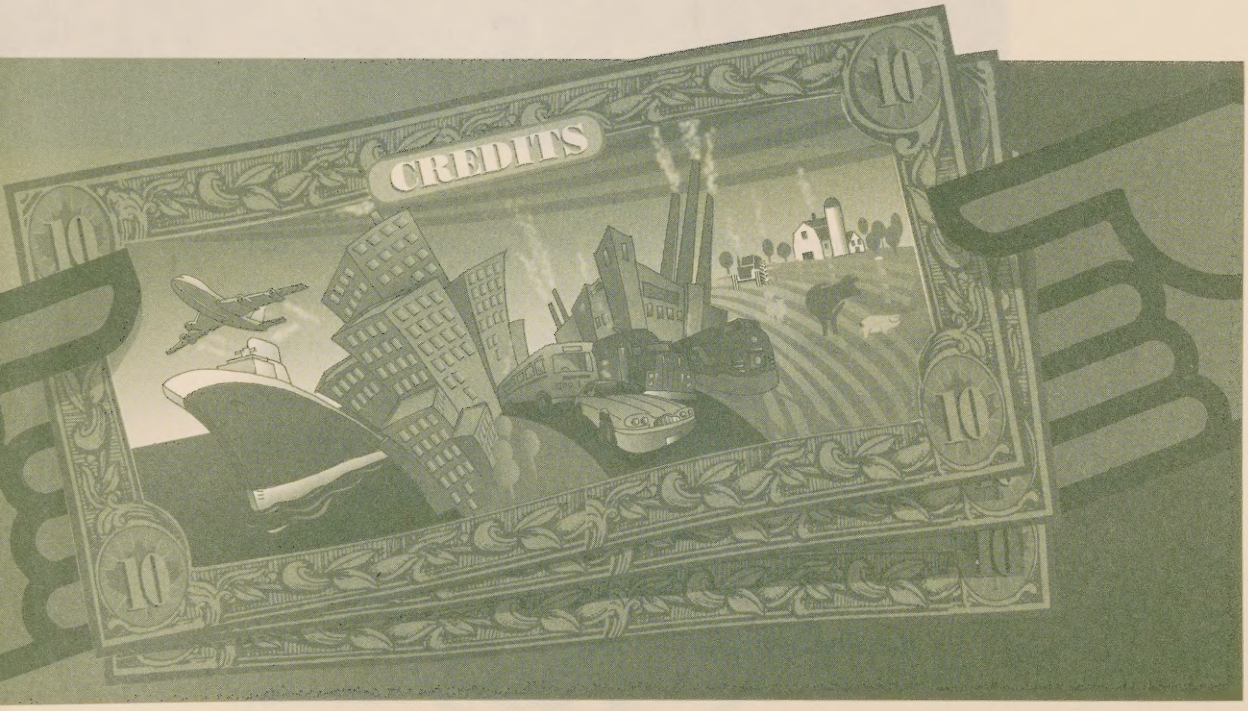

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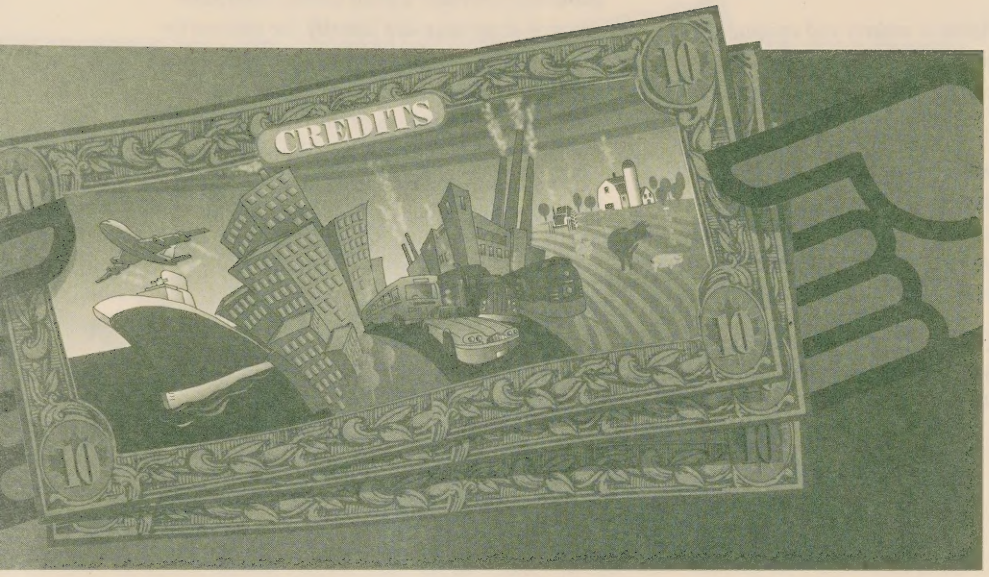

The National Round Table on the Environment and the Economy (NRTEE) was created to "play the role of catalyst in identifying, explaining and promoting, in all sectors of Canadian society and in all regions of Canada, principles and practices of sustainable development." Specifically, the agency identifies issues that have both environmental and economic implications, explores these implications, and attempts to identify actions that will balance economic prosperity with environmental preservation.

At the heart of the NRTEE's work is a commitment to improve the quality of economic and environmental policy development by providing decision makers with the information they need to make reasoned choices on a sustainable future for Canada. The agency seeks to carry out its mandate by:

- advising decision makers and opinion leaders on the best way to integrate environmental and economic considerations into decision making;
- actively seeking input from stakeholders with a vested interest in any particular issue and providing a neutral meeting ground where they can work to resolve issues and overcome barriers to sustainable development;
- analyzing environmental and economic facts to identify changes that will enhance sustainability in Canada; and
- using the products of research, analysis and national consultation to come to a conclusion on the state of the debate on the environment and the economy.

The NRTEE has established a process whereby stakeholders themselves define the environment/economy interface within issues, determine areas of consensus and identify the reasons for disagreement in other areas. The multistakeholder approach, combined with impartiality and neutrality, are the hallmarks of the NRTEE's activities. NRTEE publications address pressing issues that have both environmental and economic implications and which have the potential for advancing sustainable development.

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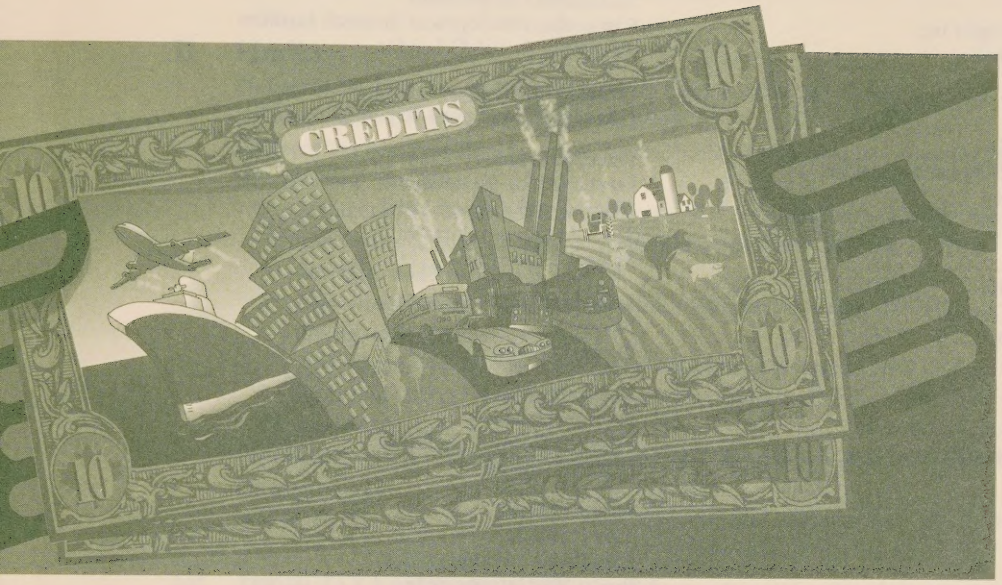

The NRTEE is composed of a Chair and up to 24 distinguished Canadians. These individuals are appointed by the Prime Minister as opinion leaders representing a variety of regions and sectors of Canadian society including business, labour, academia, environmental organizations, and First Nations. Members of the NRTEE meet as a round table four times a year to review and discuss the ongoing work of the agency, set priorities, and initiate new activities.

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Preface

For Canada to work toward meeting its Kyoto commitments to limit greenhouse gas emissions, Canadians will want to know the cost, who pays and what benefits will be derived from this action. *Emissions trading is a way to attain the greatest success for the least cost and to do so in a transparent and equitable manner.*

In addition, if the Kyoto Agreement to limit greenhouse gas emissions is to be implemented by the United States and other developed countries, it is clear that international trading of emission reduction credits will be required. For Canadian firms to participate effectively, a Canadian domestic program needs to be in place.

The National Round Table on the Environment and the Economy (NRTEE) believes that Canadian citizens and firms need to understand that emissions trading will soon play a major role in our economy and in our lives. With this report, the NRTEE has now published 10 documents on domestic emissions trading. We have also organized an international symposium to compare domestic trading programs from around the world. The question now is which program design best suits our needs.

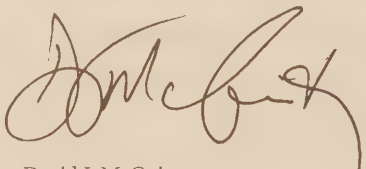
Voluntary emissions trading, while unlikely to be sufficient by itself, should be encouraged and credits for early participation should be guaranteed. As to mandatory programs, all have their strengths and weaknesses. The option that holds the most promise would closely link the measures taken to the resulting reduction in GHG emissions. Under that option, limited emission allowances would be granted to the largest emitters (industries and utilities); to exceed those limits, they would have to purchase additional allowances or credits from sources at home and abroad who have achieved reductions greater than called for. The transportation sector would require a different approach and could be treated by the use of permit trading, regulations, taxes or a combination of such methods.

Two other mandatory programs have been studied in the NRTEE's work. One calls for mandatory standards, expressed as energy used per unit of output, with tradable credits given to those who exceed the standard. This would give industry the most flexibility; however there is a concern that it would necessitate the creation of an excessive number of new standards. The other proposal would force energy prices to increase by obliging producers and importers of fossil fuel to buy permits either in Canada or abroad for any fossil fuel they sell over and above their permitted Canadian limit. While such a program would be relatively simple to administer, people could find it difficult to link the price increase to the resulting decrease in GHG emissions. This could be interpreted by some as a form of unacceptable carbon tax.

The NRTEE believes that emissions trading has the potential to become a multi-billion dollar activity. We urge others to proceed immediately with the analysis crucial to the selection of one or some combination of the above program options and design the appropriate emissions trading program. We are very grateful to the members of the multistakeholder expert group who worked diligently, cooperatively and in a thoroughly collegial and professional manner to analyze the proposed alternatives. We personally found the debate both enjoyable and informative.

Emissions trading lies at the heart of our mandate on the environment and the economy and our publications are intended to help Canadians engage in informed debate on this important subject.

Stuart L. Smith, M.D.
Chair, NRTEE



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Elizabeth May
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Sierra Club of Canada

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Pollution Probe

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President
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Staff:
Elizabeth Atkinson
Senior Policy Advisor, NRTEE

National Round Table on the Environment and the Economy Emissions Trading Multistakeholder Expert Group

Jean Bélanger
Chair, NRTEE Economic Instruments Committee

Warren Bell
Air Resources Branch
Ministry of Environment, Lands & Parks
Government of British Columbia

Doug Bruchet
Canadian Energy Research Institute

Jim Campbell
Natural Resources Canada

David Coates
Ontario Hydro

André Couture
Ministère de l'environnement et de la faune
Gouvernement du Québec

Philippe J. Crabbé
Institute for Research on Environment and Economy
University of Ottawa

Peter Dickey
TransAlta Corporation

John Dillon
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Robert A. Flemington
VCR Inc.

Dave Goffin
Canadian Chemical Producers Association

Bill Hamlin
Manitoba Hydro

Doug Harper
Environmental Sciences and Standards Division
Ministry of Environment
Government of Ontario

Al Howatson
Conference Board of Canada

Richard Hyndman
Faculty of Business
University of Alberta

Bruno Jacques
Program Development Division
Environment Canada

Brian Jantzi
Ontario Hydro

Linton Kulak
Shell Canada Ltd.

Gordon Lambert
Suncor Energy Inc.

Don MacDonald
Environment Affairs, Planning & Development
Department of Energy
Government of Alberta

Leigh Mazany
Economic Development and Corporate Finance Branch
Department of Finance
Government of Canada

Bob Mitchell
Environment Affairs, Planning & Development
Department of Energy
Government of Alberta

Ron Nielsen
Ecological Interpretations

Ken Ogilvie
Pollution Probe

Steven D. Pomper
Alcan Aluminium Limited

Chris Rolfe
West Coast Environmental Law Association

John Sargent
Department of Finance
Government of Canada

Adam White
Ministry of Energy, Science and Technology
Government of Ontario

Richard Williams
Westcoast Energy Inc.

Observer:
Ellen Burack
Climate Change Secretariat

Writers:
Erik Haites
Margaree Consultants Inc.

Robert Hornung
Pembina Institute

Facilitator:
Rob Macintosh
Pembina Institute

Staff:
Elizabeth Atkinson
Senior Policy Advisor
NRTEE

I. Introduction

The National Round Table on the Environment and the Economy (NRTEE) initiated a project in the spring of 1998 to examine possible designs for a domestic emissions trading program for greenhouse gases (GHG). Alternative designs for a domestic GHG emissions trading program were selected and refined with advice from a Multistakeholder Expert Group.[1] The experts represented various stakeholder groups but met in their personal capacities to cooperatively analyze the different approaches to domestic emissions trading and to provide direction for further work. This report describes the five trading program designs developed and the results of their evaluation by the Multistakeholder Expert Group.

The project was launched with a document that outlined 14 different potential emissions trading programs and 16 different design issues that apply to multiple designs. That document, *Possible Designs for a Domestic Emissions Trading Program for Greenhouse Gases* (July 1998), is included as Appendix 1.

Nine issues were selected for more detailed analysis. Reports on these design issues have been published separately under the following titles:

- *The Legislative Authority to Implement a Domestic Emissions Trading System*
- *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks*
- *Analysis of Options for* Gratis *Distribution of Allowances*
- *Analysis of Options for Distributing Allowances by Auction*
- *Analysis of Emissions Trading Program Design Features*
- *Possible Criteria for the Creation of Emissions Reductions Credits Under a Domestic Emissions Reduction Credit Trading Program*
- *Policies That Could Complement a Domestic Emissions Trading System for Greenhouse Gases*
- *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program*
- *What Are the Implications of Calculating GHG Emissions on a Life-Cycle Basis for the Design of Domestic Emissions Trading Systems?*

The five possible domestic GHG emissions trading programs analyzed are described briefly below. The first design, *Voluntary Credit Trading (VCT)*, assumes that Canada faces the prospect of a future commitment to limit its GHG emissions. The other four designs all are intended to help achieve a national commitment to limit GHG emissions. Due to this difference in the assumed policy setting, comparisons of the strengths and weaknesses of different designs involve only the last four program options. All options assume that if the Kyoto Protocol is ratified and enters into force, participants in the domestic emissions trading program will have access to the Kyoto Protocol mechanisms (international emissions trading, joint implementation and the clean development mechanism).

The five trading program design options evaluated are:

Voluntary Credit Trading (VCT): In this design, some emission sources voluntarily create emission reduction credits by documenting the impacts of specific emission reduction or sequestration measures they have implemented. Other entities voluntarily purchase some of these credits. A VCT program larger than the existing pilot programs would require explicit incentives for participation.

Mandatory Performance Standards with VCT: To meet its binding national commitment, Canada is assumed to impose performance standards (e.g., GHG/unit of output) on large GHG emitters and also establish performance standards for appliances, equipment, vehicles and buildings used by small GHG emitters. Emission reduction credits are created by entities that exceed the applicable standards and can be used by other entities to help comply with the standards.

Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions: To meet the national commitment, it is assumed that all fossil fuel producers and importers are required by regulation to hold allowances equal to the carbon content of their products sold in Canada. Most sources of other GHG emissions are also required to hold allowances equal to their actual emissions. A limited number of allowances, consistent with Canada's national commitment, are made available. Participants with excess allowances can sell them to participants that do not have enough. Emission reduction credits created by sources outside the program can also be used to help meet regulatory requirements.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT Excluding Transportation — Description of the Program: To help meet the national emissions limitation commitment, all large point sources of GHG emissions are required by regulation to hold allowances equal to their actual emissions. A limited number of allowances, consistent with the contribution these sources are expected to make to Canada's national commitment, are made available. Participants with surplus allowances can sell them to participants that do not have enough. It is also possible to use emission reduction credits created by sources outside the program to help meet regulatory requirements.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT and Upstream Carbon Content Trading for Transportation Fuels: This program builds on the preceding design by requiring petroleum refiners and importers of transportation fuels to hold allowances equal to the carbon content of the fuels they sell in Canada. Like all other participants in the program, they can sell or purchase allowances, and can also use emission reduction credits created by sources outside the program to help meet regulatory requirements.

This report begins with an overview of the broad conclusions that can be drawn from the NRTEE work. These conclusions are that:

- emissions trading can play a useful role in Canada's climate change action plan
- voluntary credit trading is a logical first step
- different trading program designs to meet a national commitment have different strengths and weaknesses
- beyond implementation of a voluntary credit trading program, further work is needed to evaluate alternative trading program designs and improve emissions inventories
- distribution allowances should gradually shift from *gratis* distribution to an auction

The report then provides a detailed description of each of the five potential domestic emissions trading options examined. Examples of existing programs similar to each option are outlined in Appendix 2.

II. Findings

Emissions Trading Can Play a Useful Role in Canada's Climate Change Action Plan

Emissions trading could make a useful contribution to Canada's efforts to reduce GHG emissions. Some of the reasons why emissions trading is an attractive option include:

- A domestic emissions trading program can reduce the cost of meeting Canada's climate change commitment. It gives participants an incentive to implement low-cost emission reduction measures in their own operations or elsewhere, providing all regulated sources equal access to low-cost opportunities for GHG emissions reduction. This increased flexibility for regulated emitters reduces compliance costs relative to traditional regulatory approaches, which do not allow such flexibility.

- A domestic emissions trading program enables a distinction to be made between who pays for emission reductions and who actually implements emission reduction actions.[2] This feature can help to address concerns about the equity of policies to reduce GHG emissions. For example, allowances can be distributed *gratis* to participants based on equity criteria, such as equal percentage reductions from historic emissions. That distribution determines the share of the overall compliance burden each source is responsible for. Each participant then looks for the lowest cost allowances from emission reduction actions in its own operations or extra reductions implemented by other sources.[3]

- A domestic emissions trading program creates a demand for emission reductions and a corresponding price signal that provides an incentive for both regulated and non-regulated emitters to innovate and take action to reduce GHG emissions.

- A domestic emissions trading program would enable Canadian emitters to gain operational experience with emissions trading to facilitate their participation in the Kyoto Protocol mechanisms (international emissions trading, joint implementation, clean development mechanism) if the Kyoto Protocol is ratified and enters into force.

While an emissions trading program has a useful role to play in helping Canada meet its climate change obligations, it is also clear that it will not do the job on its own. Complementary measures (e.g., standards, taxes, information programs) will be required to address sources not participating in the program and to remove non-financial barriers to the implementation of cost-effective GHG emission reductions. The scope of the complementary measures required depends on the design of the emissions trading program.

Voluntary Credit Trading Is a Logical First Step

At this time, the federal and provincial governments have not indicated that Canada plans to develop a regulated domestic GHG emissions trading program. If such a decision is ultimately taken, it will require several years to design and implement.

In the interim, Canada could implement a voluntary credit trading program. Two pilot emission reduction credit trading programs already are under way in Canada.[4] Moreover, federal and provincial governments have already made a commitment to "... establish by early 1999 a system for crediting verifiable early actions to reduce GHG emissions against any future emissions obligations"[5] and have indicated that this system should facilitate trading in GHG credits.[6]

The NRTEE's Multistakeholder Expert Group strongly supported rapid implementation of a voluntary GHG credit trading system on a scale beyond that of a pilot program. Some of the reasons for implementing a voluntary credit trading program as quickly as possible are that voluntary credit trading:

- offers governments and participants an opportunity to gain experience with emissions trading prior to the development of a formal regulated domestic GHG emissions trading program or the launch of the Kyoto mechanisms

- provides companies with one mechanism to manage the risk that future regulatory obligations to reduce GHG emissions will be imposed upon them

- can build on the fact that many companies have already made voluntary commitments to reduce GHG emissions
- can provide a clear incentive for taking action now to reduce GHG emissions
- has political support
- does not prevent the subsequent adoption of a regulated domestic emissions trading program (all of the options studied by the NRTEE actually incorporate some voluntary credit trading)

But a number of design issues remain to be addressed before a voluntary credit trading system can be fully implemented. Some of these key issues include:

- providing a clear incentive to create credits by identifying potential uses for the credits
- establishing criteria and procedures for credit creation (including the issues of baselines and additionality)
- establishing measurement, verification and reporting procedures, including the creation of a registry to record credit creation and credit trades
- identifying limits, if any, on the number of credits that can be created

The Multistakeholder Expert Group urged governments to make it a priority to address these issues to the level of detail required to make a voluntary credit trading system operational.

Different Trading Program Designs to Meet a National Commitment Have Different Strengths and Weaknesses

It is highly unlikely that a voluntary GHG credit trading system will generate the emission reductions required to allow Canada to meet its potential obligations under the Kyoto Protocol. The NRTEE studied four domestic GHG emissions trading programs with the potential to make a substantial contribution to meeting a national emissions limitation commitment. Which of these systems is most suitable for Canada?

The NRTEE Multistakeholder Expert Group identified evaluation criteria that could be used to assess the different designs and ranked the four designs using the following criteria:

- *Administrative Burden:* The cost borne by governments to establish and administer the system.
- *Transaction Costs:* The cost borne by entities to participate and make trades in the system.
- *Economic Efficiency/Cost Effectiveness:* The cost borne by society to achieve a given level of emission reductions. This is influenced by the number of participants in the system, the share of total emissions covered, and the incentives and opportunities provided by the system for innovation.
- *Political Feasibility:* The degree of public understanding of the linkage between the action taken and the resulting GHG emissions reduction would aid the acceptance of the emissions trading program design. This criterion is also influenced by the extent to which different governments are required to cooperate to establish and administer the system.

The results of the ranking by the NRTEE Multistakeholder Expert Group are presented in Table 2.1. The Table indicates which design option was judged to be best or worst in terms of meeting each criterion. It must be stressed that the results presented in the Table were not unanimous — clear minority views were also expressed — but the conclusions presented represent the views of a majority of the group. Therefore, these views should be used as a guide for further analysis and not as a definitive assessment of the merits of each option.

As illustrated in Table 2.1, a majority of the Multistakeholder Expert Group concluded that of the four domestic GHG emission trading systems considered to help meet a national emissions

limitation commitment, the Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions trading program was the most cost effective and produced the lowest administrative burden and transaction costs. Despite these attractive features, the group also concluded that this design was the one with the lowest political feasibility.

Mandatory Performance Standards with VCT, on the other hand, was judged to be the least efficient design and most costly design for governments and participants, but it was perceived to be more politically feasible than a trading program focused on the carbon content of fossil fuels. Finally, the remaining two options were judged to be somewhere in the middle in terms of efficiency and costs. This may explain why a Downstream GHG Emissions Allowance trading program was seen to be the most politically feasible option.

The four designs can be viewed as spanning a spectrum that ranges from a regulatory program complemented by voluntary credit trading (Mandatory Performance Standards with VCT) to an emissions trading program with complementary regulations (Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions). Any intermediate program, which could be a mix of the different designs, could be implemented. The results suggest that the greater the flexibility allowed by the design, the lower the costs for governments, participants and society as a whole. Political feasibility requires that the compliance burden be perceived to be distributed in a fair and reasonable manner. An intermediate design that relies primarily on regulations for some sources and primarily on emissions trading for other sources may perform best on this criterion.

A number of additional factors need to be considered before a final decision can be taken about which domestic GHG emissions trading system is most appropriate for Canada. Some of these factors include the:

- equity implications of the system for participants, regions of Canada, and different segments of society

Table 2.1
Initial Assessment of NRTEE Design Options Against Four Basic Criteria

	Mandatory Performance Standards with VCT	Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions	Downstream Greenhouse Gas Emissions Allowance Trading with VCT	Downstream Greenhouse Gas Emissions Allowance Trading with VCT and Upstream Carbon Content Trading for Transportation Fuels
Share of Total GHG Emissions Covered	50% rising gradually to 80% to 90%	Over 90%	44%	67%
Number of Participants	700 to over 5,000	500 to 1,000	1,000 to 1,200	1,000 to 1,200
Administrative Burden	Worst	Best		
Transaction Costs	Worst	Best		
Economic Efficiency/ Cost Effectiveness	Worst	Best		
Political Feasibility		Worst	Best	

- ability of the system to evolve and adapt to changing circumstances (e.g., changes in emitters or emission reduction commitments)
- extent to which complementary policies are required and the extent to which those policies have an impact on the costs and efficiency of a national effort to reduce GHG emissions
- potential impacts on international competitiveness
- potential for emissions to "leak" from participants in the system to entities outside the system
- extent to which the system will engage consumer action and behavioural change
- likelihood that the system will be compatible with proposed international emissions trading mechanisms and international trade agreements

The NRTEE Multistakeholder Expert Group was not asked to assess the four design options against these criteria. Such an evaluation would require better definitions of the criteria, more detailed design of the options, and some macroeconomic analysis (via models). The available time and resources did not permit such an evaluation. Until the necessary work is completed, the NRTEE felt it would be premature to demand that stakeholders make a choice about what domestic GHG emission trading program would be most appropriate for Canada.

Mandatory Performance Standards with VCT — Strengths and Weaknesses

The merits of this design depend heavily on the number of standards required. A larger number of standards allows more equitable treatment of participants facing different circumstances, although greater equity is not guaranteed and efficiency may be reduced. But a larger number of standards entails higher administrative costs to develop and update the standards. To reduce the cost of achieving the emissions limitation commitment, the standards should be designed to encourage production of lower emitting products. That suggests, for example, a single standard for generation of electricity regardless of the generation mix used and a single corporate average emissions standard for light-duty vehicles regardless of the mix of models sold. This helps keep the number of standards small, but can create equity concerns.[7] No information is available on the number of standards likely to be required by this design option.

Strengths identified for this trading program design by the NRTEE Multistakeholder Expert Group include the following:

- There is an immediate compatibility with existing credit-based pilots, entity-based reductions being discussed by the Credit for Early Action Issue Table, and a voluntary credit trading program.
- It accommodates new entrants, growth and exiters well.
- It stimulates innovation for production processes and products subject to the standards.
- The design does not need to be implemented completely at one time; rather implementation proceeds as the standards are developed.
- This option offers an easy way for small producers/consumers to get a baseline relative to which they can develop credits (for example, by buying a piece of equipment that exceeds the standard).

Weaknesses identified for this trading program design include:

- Although the voluntary credit trading provisions make this design more efficient than a purely regulatory regime, it is likely to be relatively inefficient because the standards may not be set in a way that promotes all of the substitution options. Also, there is no opportunity to raise revenue that can be used to reduce distorting taxes and improve the efficiency of the economy and deal with some of the downstream equity issues.

- Experience suggests that standards are sometimes difficult to implement and enforce. Such difficulties would reduce the effectiveness of the program and create equity concerns.
- If participants were not also required to meet regulated limits on absolute emissions, the standards would need to be set and be revised so that the national commitment would be met despite fluctuations in output and product sales.
- The emissions addressed through product standards for appliances, equipment, vehicles and buildings have an impact only gradually as existing stocks of these items are replaced.

Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions — Strengths and Weaknesses

Strengths identified for this trading program design by the NRTEE Multistakeholder Expert Group include:

- This option provides good coverage of total GHG emissions with a manageable number of participants.
- If some or all of the allowances are auctioned, the revenue can be used to reduce existing distortionary taxes and to address equity and adjustment issues.
- The number of allowances to be distributed is directly linked to the national emission limitation commitment.
- The administrative burden is small due to the simplicity of the program, the reporting requirements and the limited number of participants.
- If allowances are auctioned and prices are published, it should be easy to translate this into the added cost for heating fuel, etc., thus increasing the transparency of the program.
- The price signal generated by the trading program enhances the feasibility of a whole suite of complementary policies for residential and commercial energy use that do not work well with lower prices.

Weaknesses identified for this trading program design include:

- Price increases downstream of the trading program will depend on the ratio of the supply elasticity and the demand elasticity, not the carbon content of the product, and so may encourage inefficient adjustments.
- A visible tax based on GHG emissions paid by the consumer may be more effective in stimulating actions to reduce emissions.
- This option appears to be directed solely at a few industries, which are likely to complain that they are being singled out even though all consumers are affected.
- If allowances are auctioned, this option could be portrayed as a carbon tax.
- Other options allow more flexibility if other countries are unlikely to meet their national commitments.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT — Strengths and Weaknesses

Key strengths of this domestic emissions trading program design identified by the NRTEE Multistakeholder Expert Group include:

- The program imposes a regulatory requirement on precisely those sectors and entities (large industrial point sources) that have the ability and resources to actively participate in and make use of an emissions trading system.
- Once the program is operational, the administrative burden on government is likely to be low given the relatively small number of participants and the relatively low operating costs.

- The program delivers a clear regulatory incentive to reduce GHG emissions to large industrial point sources, not just a price signal.[8]
- The program provides non-participants with an incentive to innovate and act to reduce GHG emissions through the incorporation of Voluntary Credit Trading.
- There is a clear precedent for this program in the United States' SO_2 emissions trading program, which will help to make it more understandable for the general public.
- The system is politically attractive because it distinguishes between big and small emitters and excludes small emitters.

The weaknesses of the trading program design identified include:

- The administrative burden of determining initial allocation levels under the program is likely to be higher than in a Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions design, but lower than in a system of Mandatory Performance Standards with VCT (tough negotiations on allocation).
- The fact that this program excludes small emitters means that a greater number of complementary policies will be required if Canada is to meet the national emission reduction commitment. This means the administrative burden to government of Canada's total response to climate change may be higher than in other programs.
- The fact that this program excludes small emitters reduces the economic efficiency of the system because the marginal cost of emissions reduction is equalized across only a small proportion of total emitters.
- The fact that this system excludes small emitters may lead to concerns about an equitable sharing of the burden between sectors.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT and Upstream Carbon Content Trading for Transportation Fuels — Strengths and Weaknesses

The NRTEE Multistakeholder Expert Group examined the strengths and weaknesses of this domestic GHG emission trading program design in relation to the Downstream GHG Emissions Allowance Trading with VCT discussed above. This design is clearly better than the preceding one in that it covers a larger portion of Canada's GHG emissions. This improves economic efficiency and reduces the potential for inequity between the treatment of the transportation sector and other sectors. At the same time, however, some members of the NRTEE Multistakeholder Expert Group felt that this design would be less politically saleable because it targeted individuals in a way that was not clearly linked to GHG emissions from the perspective of the consumer.

Distribution of Allowances Should Gradually Shift from *Gratis* Distribution to an Auction

An important issue in the design of a mandatory emissions trading program is whether the allowances are issued *gratis* or sold at auction. A *gratis* distribution can compensate participants for the loss in value of their assets due to the imposition of a regulatory limit on GHG emissions. The NRTEE Multistakeholder Expert Group concluded that some or all of the allowances should be distributed *gratis* to participants initially with a gradual transition to an auction of some or all allowances. The speed of the transition should be influenced by both the rate of turnover of capital stock and the extent to which participants in the program can offset the decreased value of their assets by increasing the price of their goods and services to consumers. Revenues raised through an auction of allowances

can be used to several ends, including providing compensation to organizations and individuals outside the trading program that incur costs as a result of the limit on GHG emissions.

Next Steps

As a result of its work, the NRTEE advocates that the following steps be taken with regard to domestic GHG emissions trading in Canada:

1. Design and implement a full-scale voluntary GHG emission reduction credit trading system.
2. Proceed with further analysis of regulated domestic GHG emission trading systems. This work should include:
    - a fleshing out of options like the four examined by the NRTEE to include specific assumptions about issues such as the allocation of allowances or the recycling of revenues raised through an auction
    - a macroeconomic analysis of these more detailed options to better understand their economic impacts (aggregate economic impacts, distribution of economic impacts, and size and direction of price signals generated)
    - an examination of jurisdictional issues surrounding the establishment and operation of these systems
3. Take steps to develop and improve GHG emission inventories at the level of entities likely to participate in any domestic GHG emission trading program.

The NRTEE work completed to date provides a useful foundation for these next steps.

III. Voluntary Credit Trading (VCT)

Description of the Program

The option described in this section is a voluntary credit trading program for greenhouse gases in the context of a potential *future* national commitment to limit GHG emissions. This reflects the current situation in Canada. Canada and a number of other countries have signed the Kyoto Protocol, which includes commitments to limit GHG emissions during the period 2008 through 2012.[9] The Protocol has not yet, however, entered into force. As a result, the prospect of a potential future commitment to limit GHG emissions exists. But there is no limit on emissions of greenhouse gases at the present time.

A voluntary credit trading program is feasible in this setting. In a voluntary credit trading program, some sources create credits by documenting the impacts of emissions reduction or sequestration measures they have implemented. Other entities voluntarily purchase some of these credits.

A voluntary credit trading program would probably be established, managed and financed by the participants. The program would likely include representatives of the various stakeholders, including sources of greenhouse gas emissions, governments as potential future regulators, environmental groups, consumer groups and labour organizations.

A voluntary credit trading program must establish a process for credit creation. The program must decide whether participants can create credits by one or both of the following approaches:[10]

- actions that reduce emissions from projected levels for the entity as a whole
- projects that reduce emissions from part of their operation without regard to changes in emissions from the rest of their operations

To ensure measurable net reductions it may be necessary to require large sources to document changes in their total emissions. Then the appropriate reporting entity needs to be specified, approaches to establishing entity baselines need to be agreed on, procedures for calculating actual emissions need to be adopted, and methods for dealing with changes in corporate structure need to be developed.

Projects to reduce emissions or enhance sequestration are usually evaluated using agreed upon criteria. Typically, credits must represent a reduction or sequestration that is real, measurable and "additional." To be additional, credits should represent real reductions from the emission levels that would otherwise prevail under the applicable voluntary and regulatory policies and measures (or higher sequestration rates than would otherwise prevail). In addition, actions to sequester greenhouse gases must lead to long-term sequestration. The Multistakeholder Expert Group felt that the criteria should be consistent with evolving international criteria for credit creation.

Voluntary credit trading programs typically review proposed credit creation actions, regardless of whether credits are ultimately expected to be approved by the regulatory authority. The review process addresses issues that arise in the application of the criteria to various emissions reduction and sequestration measures. The review could be performed by experts from participating organizations or by an independent third party.[11] The review often involves judgments as to what are "reasonable" specifications for the baseline, measurement accuracy, monitoring cost, long-term sequestration and so on.

If governments provide incentives to program participants, such as purchases of credits or credit for early action, they will want to negotiate the credit creation criteria and review and/or approval process with the program participants. Getting agreement among the participants and the governments on the criteria, review process and the incentives to be provided is likely to take, at a minimum, several months.

Voluntary credit trading programs usually also review proposed credit uses. The main uses for credits during the course of a voluntary trading program are to meet a voluntary commitment or to partially offset emissions in the hope of forestalling a regulation.[12] The decision to use credits will be based on a strategic assessment of the possible implications for the distribution of responsibility for reducing emissions under a future regulatory regime. Once a decision to use credits has been made, the main concern for greenhouse gas credits is whether the proposed use leads to increases in ancillary emissions that could have adverse human health or environmental impacts.

One way to expand the range of potential uses for credits in a voluntary credit trading system is for government to initiate a program of credit for early action. Such a program can establish specific uses toward which credits can be applied.[13] The value of the credits obviously depends on the

nature of the "credit for early action," the price offered, or the uses allowed. The level of activity will depend on the value given to the credits by the government commitment.[14]

Every voluntary credit trading program has a registry to track the credits created, changes in ownership and credit uses. Some programs develop a registry to meet their specific needs, while other programs contract for the use of an existing registry. Like all operating decisions, this choice is made by the participants.

Three pilot programs of this type have already been established: the PERT and GERT pilot programs in Canada, and the "project-based" stream of the NESCAUM demonstration program in the United States. Historically, the number of sources that create or use credits in a pilot program ranges from 10 to 25.

The PERT and GERT projects have received general commitments from participating governments concerning recognition of the credits created toward potential future obligations. A larger scale voluntary credit trading program would require a government commitment that gives the credits a much more certain value, such as an explicit commitment to accept the credits fully toward compliance with future regulatory obligations, to purchase (and retire) credits at a specified price, or to defer implementation of regulatory measures.

A larger scale voluntary credit trading program would presumably have many more participants than a pilot program, say at least 100. With this many participants it would be impractical to operate by consensus. Thus the participants would have to establish an organization to administer the trading program, reporting to a board of directors or executive committee.

Objectives of a Voluntary Trading Program

A voluntary credit trading program in the context of a potential future national commitment could have any of several objectives. Such a program could, for example, seek to:

- demonstrate the feasibility and cost of a wide variety of emission reduction and sequestration actions
- gain a better understanding of the issues involved in emissions trading
- achieve emission reduction targets at lower cost
- defer implementation of regulations governing greenhouse gas emissions

The objective(s) obviously affect the structure of the program and how its success is measured and need to be clearly defined at the outset. The Multistakeholder Expert Group stressed that the goal(s) of the trading program should be explicit, practical and credible.

The objective(s) could affect the range of gases/sources covered by the program, the number of participants required to be successful, the incentives needed, and the structure of the program. For example, if the objective is to demonstrate the feasibility of emissions trading for a variety of different emission reduction and sequestration actions, then only one or two projects of a given type are needed and each project could be small. On the other hand, if the objective is to defer regulations governing greenhouse gas emissions, the actions need to be implemented on a scale sufficient to reassure the government that future emissions commitments can be met through voluntary action.

Greenhouse Gas Emissions Coverage

The greenhouse gas emissions sources and sinks covered by a voluntary credit trading program in the context of a potential future national commitment can be determined by the program participants. Including as wide a range of sources and sinks as possible is desirable to gain experience with issues specific to different sources/gases and sinks and to get as much diversity in control costs as possible.

The Multistakeholder Expert Group agreed that the trading program should be as comprehensive as possible. In addition to sources of energy-related emissions, it should include as many non-combustion sources as possible, provided that actual emissions or carbon sequestration can be measured, and avoided emissions can be estimated, with reasonable accuracy. The trading program should be national in scope, although regional or sectoral sub-groups could operate within the national structure. The voluntary trading program should also be integrated with the international flexibility mechanisms.[15]

A full-scale voluntary credit trading program would, in the view of the Multistakeholder Expert Group, require incentives for participants, such as:

- a program of "credit for early action"[16]
- purchases of credits by governments
- exemption from greenhouse gas emissions regulations for participants[17]

The incentive offered could limit the range of gases/sources and sinks covered by the program. Government(s), for example, may restrict the "credit for early action" or purchase credits from specified gases/sources and sinks in anticipation of future regulatory policies. To the extent that such limitations can be anticipated, they will tend to focus actions on measures likely to satisfy the future regulatory policies.

Sources Required to Participate in the Program

Participation is voluntary, so no sources are required to participate in the trading program.

Depending upon the objective(s) of the trading program, however, it might be open to any interested person or organization or only to those that meet specified criteria. The objective(s) might also require participation by a minimum number of sources, or by a large share of emissions by a specified category of sources. For a program aimed at demonstrating the feasibility of a variety of emission reduction and sequestration actions, a diversity of sources is more important than a large number of participants.

The Multistakeholder Expert Group concluded a new voluntary credit trading program should operate on a larger scale than the existing PERT and GERT pilot programs, and that a voluntary credit trading program should seek to achieve a measurable reduction from projected emissions by the participants. This would require participation by a substantial number of sources, at least 100, accounting for a reasonable share of the target emissions.

Number of Sources Involved

Since participation is voluntary, it is difficult to project how many sources will choose to become involved. Participation entails commitments of money, staff time, and emissions reduction or sequestration actions or credit purchases. As discussed earlier, a large scale voluntary credit trading program would require a mechanism to give greater value to the credits: some form of "credit for early action," government purchases of credits, or deferred regulation of greenhouse gas emissions. The level of participation and of credit creation and trading activity will depend on the value given to the credits by the government commitment.

Many of the reasons for participating in a voluntary credit trading program are specific to each firm. Thus, it is difficult to predict how many sources will consider that one or more of these reasons is important enough to incur the costs of participating in such a program.

The number of participants in a voluntary credit trading program may also reflect the objective(s) of the program. It may need to encompass a sufficient number of the sources or share of total emissions from a sector or region to be credible as a means of achieving an emissions reduction target. Alternatively, representation of a variety of different sources may be sufficient to achieve the objective(s).

Participation might increase if regulatory policies become more imminent, especially if credit trading is among, or preferred to, the policy options being considered to meet the future commitment. As an order of magnitude, it is likely that a large scale voluntary credit trading program would need at least 100 sources as participants.

Share of Total Emissions Covered by Participants

Because it is difficult to project how many sources will choose to become involved, it is also difficult to estimate the scale of the credit creation and use actions they will undertake.

Coverage can be measured in terms of the share of total sources covered, share of total emissions covered, or share of emissions reduced. In pilot programs, the number of participants is small (10 to 25), and they generally represent only a small percentage of all sources and total emissions of the relevant pollutants. Likewise, the credits created (used) in a pilot program typically represent only a small fraction (less than 1%) of the total emissions of the same pollutant by the entities creating (using) the credits.

The incentives for participants in pilot programs to implement emissions reductions historically have been very weak. A full-fledged voluntary credit trading program would require stronger incentives, such as "credit for early action," government purchases, or agreement to defer emissions regulations for participants. That would probably lead to both larger emissions reductions by participating sources and broader participation, thus substantially raising the share of total emissions covered.

On the other hand, governments tend to be concerned about the commitments entailed by incentives such as "credit for early action" and government purchases of credits. So strong incentives may be accompanied by limits on the total incentives available. A limit on the total incentives available would tend to restrict participation to a level consistent with that limit.

Administering the Program

A voluntary credit trading program would likely be established, managed and financed by the participants. The program would probably include representatives of the various stakeholders: sources of greenhouse gas emissions, governments as potential future regulators, environmental groups, consumer groups and labour organizations.

A typical organizational structure includes an executive committee, an operations committee and various task forces:

- The executive committee or board of directors provides policy direction and meets relatively infrequently. Members are typically senior staff from the organizations represented.
- The operations committee guides the day-to-day operation of the program and typically meets monthly. Members of the operations committee are staff from participating organizations knowledgeable about environmental issues or emissions trading.
- Task forces or subcommittees are often established to deal with specific issues. They typically consist of members of the operations committee, supplemented by additional experts.

Participants agree on a budget. This requires them to agree on a fee structure, which may include membership fees for various categories of participation and fees for various activities, such as review of a credit creation, use or trade. When developing the budget, participants also agree on issues such as day-to-day operation of the program, funding participation by non-profit organizations, and outreach activities such as workshops.

Voluntary credit trading programs typically review proposed credit creation actions, regardless of whether credits are ultimately expected to be approved by the regulatory authority. The review process addresses issues that arise in the application of the criteria to various emissions reduction and sequestration measures.

The review could be performed by experts from participating organizations or by an independent third party.

A registry is established. Every voluntary credit trading program has a registry to track the credits created, changes in ownership and credit uses. Some programs develop a registry to meet their specific needs, while other programs contract for the use of an existing registry. Like all operating decisions, the choice of a registry is made by the participants.

Assuming that the program involved at least 100 participants, it would need to establish an organization to administer the trading program, reporting to a board of directors or executive committee chosen by the participants. It might also need to hire employees or contracted staff for its day-to-day operation.

Measuring Emissions

Participants must establish a process for credit creation. Credits are created by sources which implement measures to reduce their emissions below a suitable entity or project baseline or to increase sequestration above a suitable baseline.[18] This means that credit creation involves specification of a suitable baseline and of criteria for credit creation. Credits could also be awarded under a "bounty" system for specified actions or projects.

Credit Creation Criteria

The Secretariat for the United Nations Framework Convention on Climate Change concluded that the baseline for a credit creation project should be constructed before the measures are implemented and should include an indication of greenhouse gas emissions expected to occur in the absence of the project.[19] In developing the baseline:

- preferential consideration should be given to using the technology that would have been the most likely *marginal* addition to the host country economy
- project boundaries should be appropriate to the scale and complexity of the activity, so as to incorporate consideration of possible leakage
- selection of the relevant time frame should be guided by consideration of the technical or financial characteristics of the activity or by policy factors

The Secretariat also concluded that the baseline for a project should remain fixed to ensure predictability for investors. But for projects with long lifetimes, participants might propose revisions to the baseline at appropriate intervals. For a given class of projects, the appropriate methodology of constructing a baseline may change over time due to technological changes or a change in the policy context.

A credit trading program could allow each emissions reduction or sequestration project to propose an appropriate baseline. This may be necessary if the projects are unique. In such cases, the baseline requires careful scrutiny as part of the credit creation review process because both the creator and the buyer of the credits have an incentive to propose a baseline that inflates the number of credits created. If a number of the credit creation projects are similar, it may be possible to define a standard baseline. This simplifies the review process and reduces transaction costs for the participants.

If there exists a prospect of a potential future national commitment to limit greenhouse gas emissions, sources have an incentive to begin to reduce their emissions to be better able to meet their potential future obligations. This incentive to begin to reduce emissions should be reflected in the baselines. In practice, it is very difficult to determine what emission reduction or sequestration actions are simply prudent business decisions. Thus, it is very difficult to define the appropriate baseline and whether the reductions are "additional" or would have occurred anyway.

Credits must represent real reductions from the emissions levels that would otherwise prevail. This involves establishing criteria the credits

must meet and establishing a process to assess credit creation actions against those criteria.[20] Typically, credits must be real, measurable and additional.[21] In addition, actions to sequester greenhouse gases must lead to long-term sequestration.

The Multistakeholder Expert Group agreed that more work is needed to operationalize the criteria, particularly to determine whether actions lead to "real" reductions that are "additional." Additionality, in particular, is very difficult to define in operational terms. A program will also need to decide whether shutting down a facility can create credits. In practice, decisions on credit creation would probably be based on previous decisions, so early participants can influence the rules by establishing precedents.

The criteria are only the starting point. Virtually every emissions reduction or sequestration project is unique in some respects. The review process addresses the issues that arise in the application of the criteria to various emissions reduction and sequestration measures.[22] That often involves judgments as to what are "reasonable" specifications for the baseline, measurement accuracy, monitoring cost, long-term sequestration and so on.

The process of reviewing an emission reduction action against the criteria to determine whether it qualifies for credits can be time-consuming and costly and so tends to exclude small emission reduction actions. A "bounty" system can be established to award credits for specific actions to reduce emissions. Specified categories of emission reduction or sequestration actions would be "pre-approved" and would earn credits in accordance with a defined formula. The action would need to be verified by a third party before credits are awarded.

Monitoring and Reporting

Each credit creation action will require appropriate monitoring systems to measure actual emissions (sequestration) and to calculate the baseline (what the emissions would have been in the absence of the action). Since the baseline can never be observed and always involves a judgment as to what is reasonable, the emission reduction can never be precisely determined regardless of how accurately the actual emissions are measured. Hence, judgment should also be exercised in selecting a monitoring system that measures actual emissions with a suitable degree of accuracy at reasonable cost.

It is important that records of actual emissions, of the calculations of the baseline, and of the determination of the number of credits created be maintained, be easily understood, and be available for scrutiny by interested parties. This is essential if the credits are to be traded. And it is essential if the credits are to be used for compliance or other purposes at some point in the future. The registry may need to include summary information on the credit creation action.

Periodic third-party audits of the records — actual emissions, baseline calculations and credit creation — can enhance the credibility of a voluntary credit trading program. The Multistakeholder Expert Group was undecided whether such third-party audits were necessary.

Liability

Two approaches to assessing credit creation actions against the criteria are possible, depending on the approach taken to liability for the validity of the credits: seller liability or buyer liability.[23]

- The trading program can establish a review process that leads to approval of the credits. Once the credits have been approved by the trading program, they can be purchased and used without risk of rejection. This approach is most consistent with a system of seller liability.
- The trading program can establish a review process, but it does not approve or reject credits. Responsibility for approving credits remains with the regulatory authority when the credits are ultimately used. This approach is most consistent with a system of buyer liability.

If a company creates and uses credits, liability is not an issue. How liability for the validity of purchased credits is shared in practice will be determined through negotiation of the sale. Under a system of buyer liability, for example, the seller could agree to replace some or all of the credits disallowed, or to compensate the buyer for part or all of the cost of purchasing replacement credits. Thus the liability is shared in a manner that is acceptable to both parties.

Life-Cycle Emissions

A trading program needs to decide whether an emission reduction action yields credits only for the emissions directly reduced or for the full life-cycle emission reduction. A life-cycle approach considers all emissions associated with the production, use and disposal of a product. In the case of a fossil fuel like natural gas it includes the emissions associated with the production, processing and transport of the gas as well as its combustion. For a product like an automobile, calculation of the life-cycle emissions can become very complex.

The main problem with awarding credits on a life-cycle basis is that it increases the potential for double counting. The source that reduces its combustion of natural gas claims the credit for lower emissions during processing and transportation. But the processing plant and pipeline might also claim credits for those reductions. It is very difficult to prevent such double counting because the specific emissions reduced at each stage in the life cycle are not identified.

Even if it is possible to design the system to prevent double counting, awarding credits on a life-cycle basis may lead to disputes over ownership. Does a source that reduces its use of natural gas own the credits for the lower processing plant emissions or do they belong to the processing plant? One way to address the double counting and ownership concerns is to award credits for upstream emission reductions only where clear title to such reductions has been established.

Finally, awarding credits on a life-cycle basis may limit the sources that can participate in the trading program. Calculation of the life-cycle emissions is tractable for fossil fuel use, electricity consumption and basic materials with relatively few inputs, such as aluminum. Calculating the life-cycle emissions associated with a complex product, such as an automobile, is too complex to be feasible for an emissions trading program. Thus, the trading program would be restricted, deliberately or by default, to sources for which calculation of life-cycle emissions is feasible.

Possible Complementary Policies

Given the potential for a future national commitment to limit greenhouse gas emissions, sources have an incentive to begin to reduce their emissions to be better able to meet their possible future obligations. Governments likewise should begin to implement policies that will facilitate achievement of the future national commitment, yet are not too costly in case the commitment does not come into force. The complementary policies should become more stringent as the potential commitment becomes more imminent.

A voluntary credit trading program could be complemented initially by other voluntary programs, such as energy efficiency targets and information programs to encourage greenhouse gas emissions reductions. If a national commitment became imminent, more costly and more compulsory programs could be introduced. These might include standards and regulations to reduce greenhouse gas emissions from new appliances, equipment, vehicles, buildings and industrial processes. Procurement standards, various economic incentives and more ambitious voluntary targets, perhaps with penalties for underachievement, could also be introduced.

As noted above, a voluntary credit trading program would require a government commitment to provide some form of "credit for early action,"

to purchase credits, or to allow the credits to be used for specified purposes to provide sufficient incentive for sources to participate on the desired scale.

Although sources have an incentive to begin to reduce their emissions to be better able to meet their potential future obligations, they also run a risk by implementing emissions reduction actions before those future obligations have been defined. Sources that begin to reduce their emissions before their future obligations are defined run a risk that those obligations will not recognize the early action. The result could be more onerous obligations for sources that have implemented early reductions (and hence benefited the environment) than for sources that have increased their emissions in the interim (and hence damaged the environment). This is clearly a perverse incentive.

Appropriate recognition or "credit for early action" can correct this perverse incentive. The "credit" could take a variety of forms, including adjustment of the baseline for determining future obligations, financial incentives such as tax credits, or a commitment to accept credits created toward compliance with future obligations. The form of the "credit for early action" could affect the severity of the policies needed to meet the future national commitment.[24]

Different forms of "credit for early action" provide different levels of incentive for emissions reduction and trading prior to actual implementation of an emissions limitation commitment. Adjusting the baseline to reflect early emissions reductions protects sources against more onerous obligations due to such actions. Tax incentives and recognition toward compliance with future obligations can provide positive incentives. Those incentives could be quite large if the baseline for determining future obligations is also adjusted. Regardless of the nature of the "credit for early action," it improves the business case for actions to reduce emissions and so should increase the volume of early emissions reductions.

Special Issues Raised by the Design

A voluntary credit trading program for greenhouse gases in the context of a potential future national commitment to limit GHG emissions does not, on its own, raise any special issues. However, the possibility that some of the credits may be used for compliance with future regulatory obligations as a result of "credit for early action" raises two issues:

- Ownership of any credits created must be clearly and unambiguously established if they can be used toward future regulatory obligations, or owners of the credits can receive other forms of "credit for early action" such as tax incentives.
- Procedures must be implemented to ensure there is no double counting or reporting of credits created.

Existing programs for voluntary greenhouse gas emissions reduction, such as Activities Implemented Jointly (AIJ) and Canada's Climate Change Voluntary Challenge and Registry (VCR) Program, suffer from double (or multiple) reporting of reductions and are not concerned with ownership. Both PERT and GERT seek to ensure that ownership is clear and that double counting or reporting is not possible. A voluntary credit trading program would need to do the same thing.

Transitional Issues Related to a Change in the Policy Setting

This voluntary option assumes the prospect of a future national commitment to limit greenhouse gas emissions. That policy setting could change in either of two ways:

- The prospect of a national commitment to limit GHG emissions no longer exists. This would be the case if the Kyoto Protocol does not come into force.

- A commitment to limit GHG emissions exists, and policies to meet that commitment are being implemented. This would be the case if Canada ratifies the Kyoto Protocol, the Protocol comes into force, and policies are implemented in Canada to meet that commitment before and/or during the commitment period.

It is also useful to consider the case where the policy setting does not change. The *prospect* of a future emissions limitation commitment remains, but the probability of such a commitment rises as a result of progress toward meeting the conditions of the Kyoto Protocol (or other international agreement).

If the prospect of a national commitment to limit greenhouse gas emissions becomes less likely or no longer exists, the voluntary credit trading program could continue to operate with no change. Participation would probably decline, since the expected benefits of learning about emissions trading, influencing future regulatory policies, and earning credit for early action would be smaller. But no specific changes would be required to the credit trading program.

If the prospect of a future commitment to limit greenhouse gas emissions becomes more likely, it might be desirable or necessary to adjust the voluntary credit trading program. Such a prospect might induce increased participation. Governments might decide that the increased prospect of a national commitment would cause sources to implement more measures to reduce their emissions. As a result, the incentives for early actions might be reduced or the baselines for eligible credit creation actions might be made more stringent. The design of the program might also change to better serve as a precursor to likely domestic policy. This suggests that periodic revisions, say every two or three years, to the voluntary credit trading program might be desirable.

If a commitment to limit greenhouse gas emissions comes into force and policies to meet that commitment are being implemented, the voluntary credit trading program would need to change. In this situation all sources of greenhouse gas emissions covered by the national commitment are expected to bear their fair share of the burden of meeting the commitment. Each source of emissions will be subject to policies that require it, directly or indirectly, to limit its emissions to a level consistent with its share of the national commitment. Some, but probably not all, sources will be required or allowed to participate in domestic emissions trading. Sources outside the trading program will be subject to other policies, such as efficiency standards, taxes, controls on products, etc.

The voluntary credit trading program then must evolve into a trading program that ensures that participating sources limit their emissions to a level consistent with their share of the national commitment. This requires that emissions limits be established for the participants and that there be effective enforcement with penalties for non-compliance. Assuming that some form of emissions trading program is implemented for the participants in the voluntary credit trading program, the options are voluntary credit trading with mandatory performance standards, or a cap and trade system with adjustments to cope with the credits for early action.

Since the voluntary credit trading program could include a diverse set of participants, it is possible that different participants might fall under different options.

It is also possible that some sources could agree to emissions limits, with penalties for failure to achieve those limits. Those sources could then operate a voluntary credit trading program amongst themselves.

Some or all of the participants in the voluntary credit trading program could be subject to mandatory performance standards once the national commitment comes into force. The performance standards could limit emissions per unit of output (input). Total emissions by these sources would then depend on the emissions

standard and the level of output (input). As discussed in the next section, such performance standards can be defined in ways that allow trading to achieve compliance. The lead in gasoline and the averaging, banking and trading (ABT) provisions of the heavy-duty engine emissions standards are examples of U.S. trading programs of this type.[25]

Performance standards defined in terms of emissions per unit of output (input) have the disadvantage of not controlling total emissions very precisely. They would need to be set so that total emissions remain below the national commitment. A cap and trade system sets a limit on total emissions and so allows more precise management of compliance with the national commitment.

Some or all of the participants in the voluntary credit trading program also could be required to participate in a cap and trade program once the national commitment comes into force. A cap on total allowable emissions by participating sources would be established. Allowances could be auctioned or distributed to participants *gratis*, using an agreed allocation rule. Participants would need to monitor their actual emissions and remit allowances equal to their actual emissions to the regulatory authority.

A program of "credit for early action" as part of the voluntary credit trading program could create credits that can be used for compliance with obligations after the national commitment comes into force. If early reductions cannot be counted toward the national commitment, as is the case under the Kyoto Protocol, the obligations imposed on sources during the commitment period have to be made more stringent by the amount of the accumulated early credits. That would require more stringent emissions standards or a lower cap on total emissions under the options described above.

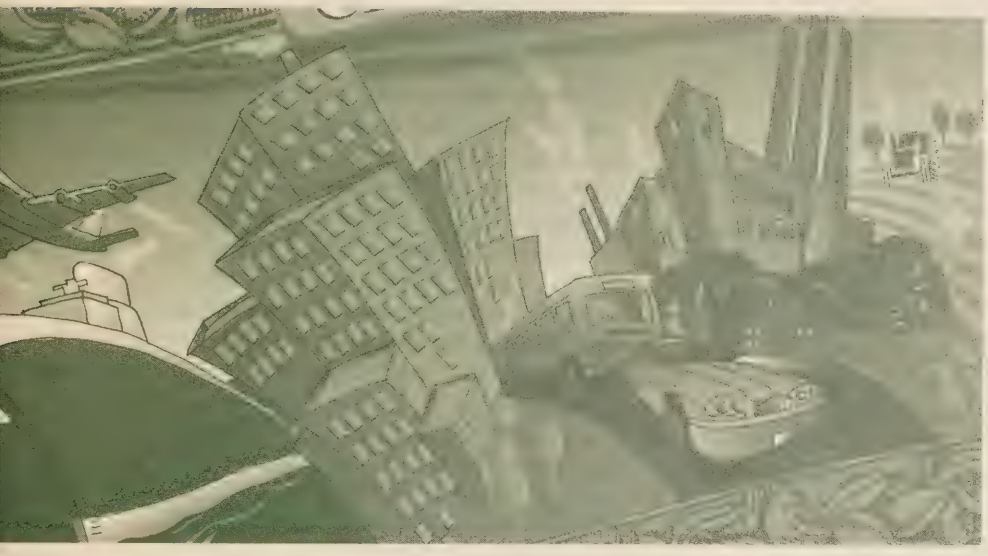
The "credits for early action" might need to meet the rules established for the trading programs implemented after the national commitment comes into force before they can be used for compliance with obligations during this period. This may reduce the quantity of accumulated credits somewhat. Using the remaining "credits for early action" for compliance under the trading programs implemented to meet the national commitment is straightforward as long as they can be expressed in the same unit (e.g., one tonne of CO_2-equivalent emissions) as the allowances or credits for the trading programs.

It is also possible that a national commitment to limit greenhouse gas emissions could be met without the use of a domestic emissions trading program. Credits created during the commitment period or "credits for early action" might still have some uses under such a regulatory regime. They could be used toward compliance with caps on total emissions or emissions performance standards where no trading is allowed. Uses embodied in U.S. credit trading programs for emissions other than greenhouse gases include:

- requiring new sources located in non-attainment areas, whose emissions exceed a specified threshold, to purchase credits created by other sources in the area at least equal to their allowed emissions
- allowing expanding sources to use credits to offset some of the increased emissions and so qualify for a simpler, less costly regulatory approval process
- requiring sources to purchase credits as part of the penalty for violating emissions regulations or as a condition for receiving a variance from environmental regulations

In summary, the transition to a policy setting where the prospect of a national commitment no longer exists requires no change to a voluntary credit trading program, although interest in the program is likely to decline. If a national commitment to limit greenhouse gas emissions comes into force, participants in the voluntary credit trading program would be subject to regulations or taxes with no trading options, mandatory performance standards with voluntary credit trading, or a cap and trade system. The transition to any of those options should be relatively straightforward, even with a program of "credit for early action."

IV. Mandatory Performance Standards with VCT



Description of the Program

This option is a program of mandatory performance standards with voluntary credit trading to meet a national commitment to limit greenhouse gas emissions.

Under this policy setting, Canada is faced with meeting a national commitment to limit its greenhouse gas emissions. In this option, governments adopt a series of mandatory performance standards to limit these emissions. Voluntary credit trading is allowed to reduce the cost of complying with the standards.

The standards and trading program are designed to cover a large share of Canada's total greenhouse gas emissions. The way in which energy-related emissions are covered is discussed first, separately for large energy users and small energy users. Then the other greenhouse gases/sources covered by the trading program are discussed.

Two types of mandatory performance standards would be established to deal with energy-related emissions:

- Large energy users, including energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines, would be subject to performance standards for energy-related emissions per unit of output.
- Emissions by small energy users would be addressed through performance standards for appliances, energy-using equipment, vehicles and buildings. Manufacturers and importers of appliances, energy-using equipment, and vehicles would be subject to performance standards for the products they sell in Canada. Builders likewise would be subject to a performance standard for buildings.

Large Energy Users

Large energy users would be subject to mandatory performance standards expressed in terms of emissions per unit of output; for example CO_2 equivalent emissions per tonne of steel, per automobile manufactured, per kilowatt hour (kWh) of electricity produced, or per dollar of sales.[26] The regulations that establish the standards also specify the sources to which they apply.[27] These sources have the option of participating in a voluntary credit trading program to comply with the performance standards.

Large energy users able to reduce their emissions below the level specified by the performance standard can create credits. Consider, for example, a widget company subject to a standard of 0.1 kilograms (kg) of CO_2 per widget that produced 1,548,000 widgets during a given year. To comply with the standard, its actual emissions would need to be less than 154.8 CO_2 equivalent tonnes.[28] If its actual emissions for the year were 150.0 tonnes of CO_2 equivalent, it could claim credits of 4.8 CO_2 equivalent tonnes. The credits could be sold to another participant in the trading program, or banked for future use if this is allowed.

A source that found direct compliance with the performance standard difficult or costly could comply by purchasing credits instead. Consider, for example, an electric utility that planned to achieve compliance with its performance standard of 0.5 kg of CO_2 per kWh for a projected load of 867 megawatt hours (MWh), assuming average weather conditions.[29] If a colder winter or warmer summer increased the load to 889 MWh and increased emissions due to greater reliance on coal-fired generation, it could purchase credits to achieve compliance. It would need to purchase enough credits to reduce the remaining actual emissions to (889 x 0.5 =) 444.5 CO_2 equivalent tonnes.[30] Thus, the performance standard establishes the baseline for credit creation and use.[31]

The mandatory performance standards are not emissions caps, because they are expressed in terms of emissions per unit of output.[32] Total allowable emissions would change as actual output changed.

The performance standards would need to be adjusted periodically to reflect changes in technology, the national commitment, or other developments. The performance standards must be defined in a manner that facilitates credit creation and use; for example, CO_2 equivalent emissions per tonne of steel rather than a requirement to install best available control technology.

A definition of large energy users[33] is needed to determine which sources are subject to the performance standards for their operations.[34] Some large energy users, such as automobile manufacturers, could be subject to performance standards for their operations as well as their products.

Product-related Emissions

Energy-related emissions by residential, commercial, institutional, small industrial and motor vehicle sources would be controlled indirectly through mandatory product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. New vehicles sold in Canada would be subject to mandatory corporate average fuel efficiency (CAFE) standards applied to all manufacturers and importers of cars and trucks. Similarly, manufacturers and importers of appliances and energy-using equipment would be subject to mandatory emissions standards for the products sold in Canada. The product-related emissions standards would specify energy-related greenhouse gas emissions for each model under specified test conditions. Builders likewise would be subject to an emissions standard for buildings.

The product-related emissions standards do not restrict sales of the appliances, equipment or vehicles or construction of new buildings during a given year. Actual emissions are determined by the use of the existing stock of buildings, appliances, equipment and vehicles, so the product-related emissions standards do not cap emissions.

Exceeding the emissions standard would create a stream of credits measured in CO_2 equivalent tonnes. Assume that a motor vehicle manufacturer sold 100,000 new vehicles in Canada during a given year and that the emissions standard for the vehicles of that type was 0.3 tonnes per year based on a specified test procedure and assumed use profile.[35] If the vehicles actually sold beat the standard by 10%, the manufacturer could claim credit for 3,000 CO_2 equivalent tonnes. Those credits would be assigned to the current and future years based on the expected life and use profile of the vehicle.[36]

An appliance manufacturer whose sales in Canada did not meet the product-related emissions standard would need to purchase a stream of credits for the current and future years based on the expected life and use profile of the appliance for the excess emissions. Thus the product-related emissions standards for appliances, equipment, vehicles and buildings also define the baseline for credit creation and use.

The credits created by appliances, equipment, vehicles and buildings must be distributed over the lives of the items that generated them if they are to be tradable.[37] Otherwise, compliance with the national commitment is compromised. Assume that all of the 3,000 credits earned by the automobile manufacturer could be used immediately by large energy users. Emissions by the energy users that purchased the credits would rise well before the reductions anticipated from the more efficient vehicles are realized. It is not feasible to apply product-related emissions standards to existing appliances, vehicles and equipment. Thus, the impact of the product-related emissions standards will only be felt gradually as the existing stocks are replaced. Unless mandatory standards are imposed well before the national commitment comes into force, the impact of the product-related emissions standards during the commitment period will be relatively small. The consequence might be a requirement for larger initial reductions from other sources.

The product-related emissions standards would limit the energy-related emissions by residential, commercial, institutional, small industrial and motor vehicle sources. These sources would not be subject to the mandatory performance standards for large energy users discussed above.[38] However, small firms that manufacture or import appliances, energy-using equipment or vehicles would be required to meet the product-related emissions standards for their products.

Other Greenhouse Gas Emissions

Where feasible, emissions of other gases/sources would be covered by mandatory performance standards with voluntary credit trading. Those gases/sources are identified in Table 4.1. Greenhouse gases other than CO_2 would be converted to CO_2 equivalents using the internationally agreed upon global warming potential

values (GWPs). Sources of these emissions and how they could be incorporated into the trading system are provided in the NRTEE Issue Paper entitled *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program.*

Credits created by exceeding the performance standards and credits created through emission reduction and sequestration actions would all be fully interchangeable.

Participants in the trading program also would have full access to all international flexibility mechanisms. If the Kyoto Protocol comes into force, these would be joint implementation (Article 6), the clean development mechanism (Article 12), and international emissions trading (Article 17). Participants could purchase allowances or credits created by any of these mechanisms and could sell surplus credits to other countries.[39]

The voluntary credit trading program would be established and administered by the regulatory authorities responsible for monitoring compliance with the mandatory performance standards. The trading program is a means of compliance with those standards, so the regulatory authority must establish the requirements for achieving compliance and then monitor the performance of the participants. However, the administrator could delegate or contract many of the functions required for the operation of the program, such as the operation of the registry.

The entity responsible for administering the trading program will need to establish rules for credit creation and use, covering such issues as reporting requirements, credit life, banking, price disclosure, provisions for sale or use of allowances or credits from other domestic or international programs, establishment of a registry, audit and verification provisions, and penalties for non-compliance.[40] These rules would be developed in the same way as other pollution control regulations, so stakeholders would have an opportunity to comment on the proposals.

One of the biggest difficulties with this design is to set the performance standards to ensure that actual emissions are less than the national commitment. The national commitment under the Kyoto Protocol is an average 6% reduction from base year emissions over the period 2008 through 2012. This commitment does not vary with the level of output. Since the standards allow total emissions to vary with output and product sales, they must be set conservatively, or other mechanisms must be instituted, to ensure that the national commitment is met.[41]

Table 4.1
Non-Combustion Sources Included in the Emissions Trading Program

Non-Combustion GHG Source	Gas	Number of Sources	Total (kt CO_2 eq)	Emission Rights Trading	Substance Trading
Landfills	CH_4, CO_2	10,000	18,250	✔	
Adipic Acid Production	N_2O	1	10,850	✔	
Aluminum Smelting	CO_2, PFCs	11	9,600	✔	
Lime and Cement	CO_2	45	7,630	✔	
Fertilizer Use	N_2O	12	4,030		✔
Ammonia (less Urea)	CO_2	10	3,800	✔	
Magnesium Smelting	SF_6	<10	1,890		✔
Coal Mining[a]	CH_4	28	1,700	✔	
Nitric Acid Production	N_2O	9	930	✔	
Other Fluorocarbons	SF_6, PFCs, HFCs	millions	500		✔

[a] Fugitive and process emissions from energy production and distribution operations.

Greenhouse Gas Emissions Coverage

The mandatory performance standards and voluntary credit trading program ultimately would cover virtually all greenhouse gas emissions directly or indirectly. It would cover large energy users — energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines — directly by making them subject to mandatory performance standards per unit of output. Residential, commercial, institutional, small industrial and transportation emissions would be covered indirectly through mandatory performance standards for virtually all buildings, appliances, energy-using equipment and vehicles sold in Canada. Emissions from these sources would be addressed gradually as existing buildings, vehicles and equipment are replaced. Most sources of other greenhouse gas emissions would be covered by mandatory performance standards or be allowed to create credits for documented emissions reduction or sequestration actions.

Mandatory performance standards would be established for all large energy users. Ideally, these standards would be defined in terms of CO_2 equivalent greenhouse gas emissions per physical unit of production. However, it may be difficult to find a comprehensive measure of physical output given the diversity of the output produced by many plants; chemical plants, for example, often produce a large number of products. In some cases it may be possible to identify a few key products that are relatively homogeneous across firms and account for a substantial fraction of total output, which could be used as proxies for total output.

A more general approach is to express the performance standard in terms of CO_2 equivalent greenhouse gas emissions per dollar of sales adjusted for inflation.[42] This value would differ for each firm for a variety of reasons, so the standard would need to be specific to each firm. Firm-specific standards could be established by taking the GHG emissions per dollar of sales for the firm in a base year (say 1995) and reducing it by some percentage.[43] Thus each firm would have its own output-based performance standard for each year. New firms in an industry could be assigned a base-year value that reflects superior performance in the industry, say the 75th or 90th percentile value for existing firms in the industry.

Manufacturers and importers of appliances, energy-using equipment and vehicles would have to meet mandatory product-related emissions standards for the products sold in Canada. These would be corporate average greenhouse gas emissions standards for new products sold in Canada, similar to the U.S. corporate average fuel efficiency (CAFE) standards for new vehicles. The product-related emissions standard would be defined in terms of a specified test procedure that reflects the use of the product so that the GHG emissions over the life of the product could be calculated.[44] Sales of products whose emissions are less than the standard generate credits, while sales of products whose emissions exceed the standard require the manufacturer or importer to purchase credits to achieve compliance.[45]

The performance standard for buildings would be reflected in the building code.[46] Builders would be responsible for meeting the building code. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions.[47] The builder would then need to purchase credits equal to the extra emissions to achieve compliance.

The gases/sources of non-energy emissions listed in Table 4.1 would be covered by mandatory performance standards with voluntary credit trading. This would include emissions from large landfills, adipic acid, nitric acid, ammonia, lime, cement and aluminum production. Emissions associated with consumption of HFCs, SF_6 and PFCs would be covered. And the N_2O emissions due to fertilizer use would also be addressed.

The main sources not covered are small landfills, methane emissions from open pit coal mines and emissions from livestock due to enteric fermentation and manure. These sources could create credits for documented emissions reduction or sequestration actions.

These standards will need to be revised periodically to reflect changes in technology, changes to the national commitment, or other developments. But the standards need to be set for some time into the future so that entities affected can implement a compliance plan. Those considerations suggest that the performance standards be defined at least five years into the future, with revisions roughly every five years.

Sources Required to Participate in the Program

As previously described, mandatory performance standards would apply to all large energy users and all manufacturers and importers of appliances, energy-using equipment and motor vehicles. All builders would also be required to meet the performance standard incorporated into the building code. Large landfills, aluminum smelters, lime and cement producers, fertilizer manufacturers and importers, ammonia producers, magnesium smelters, nitric acid and adipic acid producers, and manufacturers and importers of HFCs, PFCs and SF_6 would also be subject to mandatory performance standards.

The number of sources subject to the mandatory performance standards could be very large. The two categories with the largest number of sources are industry and builders. There are roughly 33,000 industrial establishments in Canada, but 75% to 80% of industrial energy use is accounted for by about 400 large establishments in energy-intensive industries, such as pulp and paper, iron and steel, chemicals, mining, smelting and refining, cement, and petroleum refining.[48]

A definition of large energy users is needed to determine which sources are subject to the performance standards for their operations. The definition should be related to annual emissions — for example, annual greenhouse gas emissions in excess of 100,000 CO_2 equivalent tonnes — but could also be based on annual sales or energy use. It is assumed that a definition would be adopted that keeps the number of participants manageable, say 400 to 2,500.

While there are many thousands of contractors, the number of general contractors responsible for construction of new buildings is not known. Building contractors are currently required to comply with the building code. Changing the building code so that it incorporates an emissions performance standard will not increase the number of builders affected. But it may increase the complexity of determining compliance with the code. Ease of administration and enforcement should, of course, be a consideration in choosing how the performance standard is reflected in the building code.

Sources that are not well suited to emissions trading and sinks would be allowed to create credits. Credits could be earned for capture of emissions from small landfills, open pit mines, and for carbon sequestration actions allowed by the international emissions limitation agreement. It might also be possible to earn credits through actions to reduce livestock-related emissions from enteric fermentation or manure.

Number of Sources Involved

As noted in the previous section, the number of industrial sources covered by the mandatory performance standards could be reduced significantly by focusing on large energy-intensive plants. That could reduce the number of industrial sources to 400 from 2,500.[49] Manufacturers and importers of energy-using appliances, equipment and vehicles would be subject to product-related emissions standards for their products. The number of firms affected depends upon the range of products affected and whether participation is limited to larger firms. As a guess, the number of firms could range from 100 to 2,500.

The number of sources of non-energy emissions, considering only large landfills, is approximately 200. The total number of sources affected, excluding builders, then would be approximately 700 to over 5,000. The upper end of this range is more than the number of participants for any existing emissions trading program. The number of builders is not known, but changing the building code would not increase the number of builders or the number of buildings that need to be inspected.

Since the credit trading program is voluntary, it is not possible to develop a very precise estimate of the number of participants. The cost savings due to engaging in credit trading will need to be less than the administrative costs. It is likely that most builders would simply comply with the performance standard as reflected in the building code rather than seek to create or use credits. Many small manufacturers and importers of appliances and energy-using equipment subject to mandatory product-related emissions standards are also likely to focus on meeting the standard rather than engaging in emissions trading.

Thus, participants in the trading program are likely to include large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways, airlines, builders, and manufacturers and importers of appliances, energy-using equipment and vehicles. Sources not subject to the mandatory performance standards but able to reduce greenhouse gas emissions without double counting could "opt in" to the trading program by selling credits created by such actions.[50]

It is difficult to estimate the number of standards involved. The number depends both on how the standards are set and what is considered to be a separate standard. If the mandatory performance standards for large energy users are defined in terms of physical output, each industry will have a different standard. If their standards are defined in terms of emissions per dollar of sales, it could be considered a single standard for all large energy users. But since each participant would have a different base year value, it also could be counted as a separate standard for each participant.

The number of standards affects the equity of the program. A single standard defined in terms of kg of CO_2 equivalent emissions per kWh of electricity generated could be considered overly generous to hydroelectric stations and unfair to coal-fired stations. Similarly, a single standard for refrigerators would penalize large capacity models relative to small bar fridges. On the other hand, setting a separate standard for each form of generation and each size of refrigerator reduces or eliminates the incentive to switch to lower emitting products.[51] Participants should have an incentive to develop and sell lower emitting models.

Equity across participants in the same and in different industries is difficult to evaluate. Firms in the same industry could be affected very differently; utilities subject to the same emissions standard per unit of output regardless of generation mix or steel plants subject to a single standard per tonne of steel produced regardless of the process used, for example. Comparing equity across industries is even more difficult; how can the treatment of an automobile manufacturer subject to a CAFE standard be compared to that of a steel plant?

It can be argued that increasing the number of standards allows more equitable treatment of participants; electric arc and open hearth steel plants have separate standards and hence can be treated more equitably. It can also be argued that increasing the number of standards means that some standards apply to a small number of plants, which may be able to negotiate a standard that is less onerous than the standards imposed on some other industries.

The number of standards clearly has implications well beyond the administrative workload involved in developing and revising the standards. The number of standards has equity implications within and across industries. And it can affect the incentives to develop and market lower

emitting products. What constitutes a separate standard is not well defined, so it is difficult to estimate how many standards would (or should) be developed. As a crude guess, the number of standards is estimated as being of the same order of magnitude as the number of participants, between several hundred and a few thousand. Some of the processes and products, such as buildings and light-duty vehicles, are already subject to standards, so the number of additional standards required is smaller still.

Share of Total Emissions Covered by Participants

Virtually all greenhouse gas emissions would ultimately be covered directly or indirectly by the mandatory performance standards. Energy-related emissions by large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines would be subject to performance standards for emissions per unit of output. The large stationary sources plus rail and air accounted for almost 50% of total energy-related GHG emissions in 1995.[52]

Energy-related emissions by residential, commercial, institutional and small industrial sources and motor vehicles would be regulated indirectly through mandatory product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. Together those sources accounted for just over 50% of total energy-related greenhouse gas emissions in 1995.[53] Most of these emissions are from mobile sources.

Energy-related emissions by residential, commercial, institutional and small industrial sources and motor vehicles would only be covered gradually as the existing stocks of appliances, buildings, equipment and vehicles are replaced. Thus, the fraction of these emissions covered during the commitment period could be quite small unless the product-related emissions standards were instituted well in advance of the commitment period. Since the emissions also depend on use, it suggests a role for complementary policies to influence the use of vehicles, appliances, equipment and buildings.

Approximately 70% of non-energy greenhouse gas emissions are covered by this design. The emissions covered include: cement and lime production, chemical production, other non-energy uses, waste incineration, fertilizer use, most landfill emissions and anaesthetic use. The non-energy sources not covered include livestock and manure, soils, prescribed burning, wastewater/compost, and wood fuels.

Assuming that mandatory performance standards for large energy users apply only to larger firms, that some share of upstream oil and gas emissions are not addressed by the standards, and that the product-related emissions standards come into effect shortly before the commitment period, the proposed system would address about 50% of Canada's total greenhouse gas emissions initially.[54] This would gradually rise to 80% to 90% of total emissions as existing stocks of appliances, buildings, equipment and vehicles are replaced.

Administering the Program

The mandatory performance standards would be developed and administered by the federal, provincial and municipal agencies responsible for regulating:

- emissions by energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines
- performance of appliances, energy-using equipment and vehicles
- the building code
- the participating non-energy sources[55]

Administration of the mandatory standards will involve all levels of government and require considerable coordination. The federal government has jurisdiction over interprovincial

transport and products involved in interprovincial and international trade. It also plays an important role in the development of the building code. Regulation of emissions is primarily a provincial government responsibility, and building inspection is a municipal responsibility.

Administration of the voluntary credit trading program could be delegated to a new entity created for that purpose. It could have a board of directors selected by the federal and provincial agencies responsible for the mandatory performance standards. The board of directors could also include representation of all stakeholder interests. This entity would develop the rules for the trading program and change them as necessary, be responsible for operation of the registry, and coordinate enforcement with the federal, provincial and municipal agencies responsible for compliance with the performance standards.

The process for developing the rules for the trading system would be similar to that used for other environmental regulations. Stakeholders would have an opportunity to comment on the proposed rules before they are adopted. The rules for the voluntary credit trading program would cover items such as:

- *credit creation* — calculation of the credits created, units of measurement, credit life, documentation required to support credit creation claims, creator liability, approval requirements, and sources not subject to mandatory performance standards eligible to create credits
- *credit use and transfer* — eligible trading program participants, eligible users, eligible credit uses, geographic or temporal restrictions on trading or use, trading ratios, consideration of ancillary environmental impacts, banking, user liability, environmental donation, and approval requirements
- *registry, reporting and monitoring* — required notices, monitoring requirements, documentation requirements, reporting requirements, price information, and confidentiality of proprietary information
- *audit and verification* — authority of the regulatory authority to require information, defer uses pending an audit, order a third party audit, determine credit eligibility, require annual reports, perform a program audit, and administer prohibitions, restrictions and penalties

The Multistakeholder Expert Group made a number of recommendations for the initial program design. Those recommendations are summarized in Table 4.2.

The entity responsible for the voluntary credit trading program would establish a registry to track ownership of credits created, traded and used. The registry could be developed and operated by the entity or it could be developed and operated under contract by a qualified organization. Any person or organization, not just entities subject to performance standards, should be allowed to engage in credit trading.

The performance standards are mandatory, while the credit trading program is voluntary. The main enforcement responsibility, then, lies with the various federal, provincial and municipal agencies responsible for compliance with the standards. Credits can be created through over-compliance.[56] A claim for credits created might require certification by the responsible regulatory agency that the entity is in good standing and that the claim is correct. Credits can also be used to achieve compliance. The responsible regulatory agency could ask the trading program administrator to verify that the credits proposed for compliance use are valid. But any penalties for non-compliance remain the responsibility of the agency responsible for the performance standard.

The entity responsible for the trading system would only be responsible for enforcing compliance with the rules of the voluntary trading program, such as proper reporting. Penalties for non-compliance would likely take the form of fines and suspension from the trading program.

Table 4.2
Key Design Issues and Proposed Choices to Address Them

Issue	Choice	Comments
Geographic Scope	• National program	• Does not matter if other countries have different approach to emission reductions
Basket of Gases and Sources	• 100% coverage of all emissions from fossil fuels • 100% coverage of other GHG emissions from listed sources	• Performance standards for production processes of large energy consumers • Performance standards for energy-using appliances, equipment, buildings and vehicles • Performance standards or emission caps for sources in Table 4.1 • Credit trading for landfills and ruminant CH_4 emissions
Creation of Competitive Market	• With 700-5,000 sources, should not be a problem	
Incorporation of All Programs into Single Market	• All participants should be in a single market	• All credits and allowances denominated in CO_2 equivalent tonnes based on internationally agreed GWP values
Metering and Testing	• Use company records as first basis	• Use standard tests, mass balance and other appropriate methods for determining compliance with the performance standards • Allow for external auditing
Liability — Seller or Buyer?	• Buyer	• Buyer should ensure that credits are valid • Seller should ensure compliance before sale
Price Disclosure	• No	• Not required for individual transactions. There will be enough transactions that brokers will be aware of prices
Transaction Costs	• Keep low	• Keep administration of the program simple to hold costs down
Banking	• Yes	• Consistent with international commitment
Credit Life	• Indefinite	
Borrowing	• No	• Avoid problem of how to deal with companies that go out of business
Compliance Period	• Annual	• Have 30-day to 60-day grace period at end of accounting year to allow companies over their limit to buy credits to comply
Penalties for Non-Compliance	• Yes	• Should reflect severity of the violation • Retire credits for excess emissions plus fines
GWP Values	• Yes — follow Kyoto	• No retroactive changes

Measuring Emissions

The mandatory performance standards for large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines take the form of allowable energy-related greenhouse gas emissions per unit of output. Each source subject to such a performance standard would be required to measure and report actual or calculated greenhouse gas emissions and actual output, measured in the appropriate units, for each year.

Actual emissions could be measured using continuous emissions monitors (CEMs) or be calculated using emissions coefficients and consumption of different fuels. Fuel consumption could be measured using fuel meters or be determined from fuel purchase records.[57] The choice of monitoring method will depend on the size of the source, the types of fuels used, the number of points that need to be monitored and the costs of different monitoring systems. Rules for monitoring and reporting actual emissions would be part of the performance standard.

Actual output must also be reported to the regulatory authority. The regulator would have the authority to audit production records, sales reports and other documents as necessary to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of output reported.

The actual emissions would be divided by the actual output to determine whether the emissions performance standard had been achieved. If the actual emissions rate was lower than the performance standard, the source could claim a credit for the difference. This claim would be certified by the regulatory authority and then posted on the registry by the source. If actual emissions were higher than allowed by the performance standard, the source would need to purchase, and provide the regulatory authority with, enough credits to come into compliance. The credits provided to achieve compliance would be cancelled.

The mandatory product-related emissions standards for appliances, energy-using equipment and vehicles would take the form of greenhouse gases emitted in the course of a specified operational cycle. The standard would define the test procedure to be used. Tests would need to be performed at specified intervals by qualified independent laboratories. Manufacturers and importers of such products would be required to supply the test results to the regulatory agency. The agency would have the power to order additional tests by a laboratory of its choice if it was dissatisfied with the test results supplied by the manufacturer or importer.

Manufacturers and importers of appliances, energy-using equipment and vehicles would also be required to report actual sales of each product in Canada during the year. The regulator would have the authority to audit production records, sales reports, records of imports and exports and other documents as necessary to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of sales reported.

Compliance would be determined by comparing the corporate average emissions (from test results for each product and actual sales of each product in Canada) with the relevant corporate average product-related emissions standard. If the calculation indicated actual emissions were lower than the standard, the source could claim a stream of credits equivalent to the reduction. The stream of credits would be calculated using specified assumptions about the use profile and life of the product. This claim would be certified by the regulatory authority and be posted on the registry by the source. If the test results indicated higher emissions than allowed by the performance standard, the source would need to provide the regulatory authority with enough credits to come into compliance. The stream of credits needed to achieve compliance would be calculated using the same assumptions about the use profile and life of the product. Credits used to achieve compliance would be cancelled.

Municipal inspectors would ensure that each new building met the requirements of the building code. The building code would reflect the emissions performance standard for different categories of buildings. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions. The builder would then need to purchase the necessary stream of credits to achieve compliance.

Non-energy sources would be covered by mandatory performance standards similar to those for large energy sources — an emission rate per unit of production — or product-related emissions standards. Adipic acid, nitric acid, lime, cement, and ammonia production as well as aluminum and magnesium smelting appear to lend themselves to such standards. Emissions from consumption of HFCs, PFCs, SF_6 and fertilizers can probably best be addressed through product-related emissions standards.

All of these sources would need to monitor or calculate actual "emissions" using methods specified by the regulatory authority. Sources subject to performance standards would also need to report their actual output to the regulatory authority. The regulator would have the authority to audit production records, sales reports and other documents as necessary to verify the accuracy of the data.

Possible Complementary Policies

Energy-related greenhouse gas emissions by large energy users would be regulated by mandatory performance standards defined in terms of energy-related GHG emissions per unit of output. Such a standard gives sources an incentive to implement the full range of energy-efficiency and conservation measures and to switch to less carbon-intensive energy sources.

Complementary policies should help these large sources implement measures to reduce their greenhouse gas emissions.[58] Possible policies include:

- information programs on emissions reduction options, including operational practices, fuel switching and more efficient technologies
- audits to identify opportunities to reduce GHG emissions
- changes to the tax code to ensure that different energy sources receive comparable treatment
- taxes or royalties on carbon-intensive fuels to provide a stronger financial incentive to implement measures that reduce energy-related GHG emissions

Energy-related emissions by residential, commercial, institutional and small industrial sources and motor vehicles would be regulated indirectly through mandatory product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. These sources account for approximately half of the total energy-related greenhouse gas emissions. Mobile sources represent 65% of the emissions from these sources.

The energy-related greenhouse gas emissions from these sources depend on how the buildings, appliances, equipment and vehicles are used. The performance standards do not affect the use. Thus, there is a role for complementary policies aimed at changing the use of these buildings, appliances, equipment and vehicles, especially vehicles, in ways that reduce GHG emissions. Since the standards affect only new buildings, equipment and vehicles, complementary policies are needed to reduce emissions from existing buildings, equipment and vehicles. As well as the changes to the tax code plus taxes or royalties mentioned for the large sources, possible complementary policies for the smaller energy users include:

- information programs on energy efficiency, energy conservation, fuel switching and other emissions reduction options
- building energy audits to identify opportunities to reduce GHG emissions
- mandatory inspection and maintenance programs for vehicles
- transportation demand management measures such as car/van pooling programs, high-occupancy vehicle lanes, public transit lanes, subsidies for public transit, restrictions on parking, higher fuel taxes, and road pricing
- government procurement programs to stimulate demand for more efficient buildings, equipment and vehicles

Many of the non-energy emissions come from a small number of industrial sources. Governments could work with industry associations and/or the affected firms to disseminate information on emissions reduction technologies or practices. However, the scope for such activities may be limited by competitiveness concerns. Programs to reduce the volume of solid waste, to encourage more efficient use of fertilizers, and to reduce the use of HFCs, PFCs or SF_6 in consumer applications could usefully complement the standards and emission caps for those sources.

Special Issues Raised by the Design

Appliances, energy-using equipment and vehicles would be required to meet mandatory emissions performance standards. Those standards would need to be the same for both domestically produced and imported appliances and equipment to be consistent with World Trade Organization (WTO) rules.[59] In addition, the standards would need to be defined in ways that do not treat imports unfairly.

In some cases it may be difficult for Canada to establish a greenhouse gas emissions performance standard alone. If Canada is a relatively small part of the total market for a product and larger markets adopt different approaches to managing the emissions from such sources, manufacturers (foreign and domestic) may not comply with the standard. However, the ability to comply by purchasing credits may still allow Canada to implement an emissions performance standard even if other countries adopt different policies.

Large industrial sources would be subject to mandatory emissions performance standards defined in terms of greenhouse gas emissions per unit of output. Those standards apply to production operations in Canada. Imported products (other than appliances, energy-using equipment, and vehicles) would not be subject to performance standards. The emissions associated with the production of the imported products are governed by the policies in the country of origin.

Petrochemical plants are among the large industrial sources that would be subject to mandatory performance standards for greenhouse gas emissions. They purchase fossil fuels for use as both an energy source and a feedstock. Since the focus is on greenhouse gas emissions and some petrochemical products sequester carbon for relatively long periods, the appropriate definition of the performance standards for the petrochemical industry needs to be carefully considered. The question of the appropriate treatment of feedstocks is discussed in an NRTEE issue paper.[60]

Other countries with national commitments could adopt performance standards, emissions taxes or emissions trading to manage their greenhouse gas emissions. The costs of Canada's policy to various industries could be higher or lower than the costs of the domestic policies adopted by other countries. The competitiveness impacts and leakage will be determined by the costs in Canada relative to its major trading partners. This is true regardless of whether Canada adopts a voluntary credit trading program with mandatory performance standards or some other policy to meet its national commitment.

Transitional Issues Related to a Change in the Policy Setting

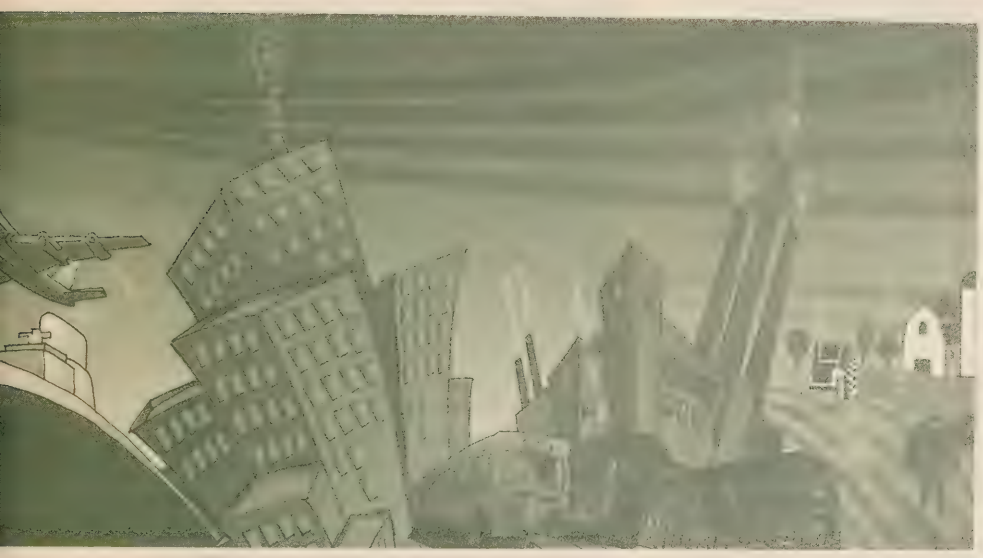
This option assumes that a national commitment to limit greenhouse gas emissions is in force. The commitment could become more stringent over time, or the commitment could become less stringent, perhaps to the point that no restrictions on GHG emissions are needed.

If the commitment becomes more stringent, the mandatory performance standards would need to be made correspondingly more stringent to meet the commitment. But no change would be necessary to the voluntary credit trading program.

If the commitment becomes less stringent, the mandatory performance standards could be maintained or relaxed. Again no changes would be needed to the voluntary credit trading program. But as compliance with the existing or relaxed standards became easier, the volume of trading activity and prices of credits could be expected to fall.

One advantage of this design is that implementation could begin early on a voluntary basis. Large energy users could negotiate performance standards with the federal or provincial governments. Product-related emissions standards could also be negotiated or mandated for selected appliances, equipment or vehicles. Indeed, early initiatives in this area may be crucial given the long lags before such standards have a significant impact on total emissions. Sources of non-energy related emissions also could negotiate performance or product-related emissions standards with the relevant governments before the national commitment came into force.

V. Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions



Description of the Program

This section discusses a mandatory cap and trade program for most sources of greenhouse gas emissions complemented by credit trading for sources and sinks not well suited to a cap and trade program. This program is assumed to be implemented to meet a national commitment to limit greenhouse gas emissions.

Energy-related CO_2 emissions are addressed by imposing a cap on the carbon content of fossil fuels used in Canada. Fossil fuel producers and importers are required to hold allowances equal to the carbon content of the products sold in Canada.[61] Each producer and importer must hold allowances equal to the carbon content of the domestically produced and imported crude oil, natural gas and coal, as well as the imported petroleum products sold. Exporters receive allowances equal to the carbon content of the crude oil, natural gas, coal and petroleum products exported.

The other gases/sources covered by the cap and trade program are shown in Table 5.1. Greenhouse gases other than CO_2 would be converted to CO_2 equivalents using the internationally agreed global warming potential values (GWPs).[62]

Credits could be earned for capture of emissions from small landfills, open pit mines, PFCs from aluminum smelting, and for carbon sequestration actions allowed by the international emissions limitation agreement. How best to address emissions from livestock due to enteric fermentation and manure needs further study.

Participants in the trading program would have full access to all international flexibility mechanisms. If the Kyoto Protocol comes into force, these would be joint implementation (Article 6), the clean development mechanism (Article 12), and international emissions trading (Article 17). Participants could purchase allowances or credits created by any of these mechanisms and could sell surplus allowances or credits to other countries.[63]

This design gives rise to two issues for fossil fuel CO_2 emissions: how close to the wellhead to implement the trading program and how to deal with fossil fuels used as non-energy feedstocks. These issues are discussed in turn.

The composition of the oil or gas recovered differs from well to well, and the composition of the oil or gas recovered from a particular well changes over time. Oil recovered from a well includes methane, which is recovered where economically feasible, flared, or released to the atmosphere. Gas recovered from a well includes CO_2, which is stripped and released to the atmosphere; impurities, such as hydrogen sulphide, which must be removed; and natural gas liquids, which are recovered and sold to oil refineries.

Table 5.1
Non-Combustion Sources Included in the Emissions Trading Program

Non-Combustion GHG Source	Gas	Number of Sources	Total (kt CO_2 eq)	Emission Rights Trading	Substance Trading
Landfills	CH_4, CO_2	10,000	18,250	✔	
Adipic Acid Production	N_2O	1	10,850	✔	
Aluminum Smelting	CO_2	11	9,600	✔	
Lime and Cement	CO_2	45	7,630	✔	
Fertilizer Use	N_2O	12	4,030		✔
Ammonia (less Urea)	CO_2	10	3,800	✔	
Magnesium Smelting	SF_6	<10	1,890		✔
Coal Mining[a]	CH_4	28	1,700	✔	
Nitric Acid Production	N_2O	9	930	✔	
Other Fluorocarbons	SF_6, PFCs, HFCs	millions	500		✔

[a] Fugitive and process emissions from energy production and distribution operations.

Considerations in the choice of whether to implement the trading program at the wellhead or further downstream include: the number of participants, the availability and accuracy of data on the carbon content of the fuel produced, and the share of total emissions covered.

There are approximately 55,000 oil wells and 50,000 gas wells in Canada, which are owned by fewer than 600 companies.[64] There are 789 gas plants and 23 oil refineries in Canada, which are owned by approximately 180 companies.[65] There are 29 coal mines in Canada, operated by 12 coal companies. There are estimated to be between 15 and 50 companies that import coal, natural gas or petroleum products and that are not fossil fuel producers. Virtually all fossil fuel exporters are believed to be producers as well. An upstream carbon content trading program would involve between 350 and 700 companies regardless of whether it is implemented at the wellhead or at the initial processing plant.

However, implementing the trading program at the wellhead would involve more companies and many more control points (wells rather than gas plants and oil refineries). Regulating over 100,000 wells, even if they are owned by fewer than 600 companies, is administratively much more complex than regulating about 800 plants owned by 180 companies.

The second consideration is the ease of determining the carbon content of the fuel produced. If the trading program is implemented at the wellhead, the carbon content of the raw gas or crude oil produced by the well must be determined. This can be calculated from the quantity of oil or gas produced and the composition of the oil or gas stream. The quantity produced by each oil and gas well is metered. The composition of oil or gas produced by each well differs and varies over time. Regulatory agencies, such as the Alberta Energy and Utilities Board, require that wells be tested periodically to determine the composition of the gas stream.

The tests required by regulatory agencies may, or may not, be sufficient to determine the carbon content for the purposes of an emissions trading program. The adequacy of those tests depends upon the frequency of the testing and the likelihood that the composition of the oil or gas stream will change significantly between tests. More research is needed to establish the appropriate testing frequency for purposes of an emissions trading program.

If the trading program is implemented at the gas processing plants and oil refineries, it could be based on the carbon content of the oil or gas received or on the carbon content of the products produced. The composition of the natural gas received by a processing plant and the crude oil received by an oil refinery varies. The composition of the unprocessed natural gas or crude oil received is tested regularly for operational reasons. The carbon content can be determined from these test results. The quantity received by each processing plant and oil refinery is recorded. Thus, the carbon content of the raw gas or oil received by each plant can be determined.

The natural gas produced by a processing plant and the products produced by an oil refinery must meet well-defined specifications and so have a carbon content that varies within a narrow range. Thus the carbon content of the output can be calculated accurately from the product specifications and the quantities produced. The carbon content of imports and exports can also be calculated from the product specifications and the quantities.[66]

If the trading program is implemented at gas processing plants and oil refineries, it should probably be based on the carbon content of the gas and oil received rather than on the carbon content of the products produced. Basing the program on the carbon content of the input streams appears to be manageable from an administrative perspective. And basing the trading program on the carbon content of the input streams addresses the emissions associated with processing. But moving the trading upstream to the wellhead will involve a much larger administrative burden.

The third consideration is the share of total emissions covered. Emissions of greenhouse gases due to upstream oil and gas activities and coal mining are estimated to represent over 7% of Canada's national total.[67] This includes fugitive methane emissions from upstream oil and gas activities, CO_2 stripped from natural gas, and fugitive methane from coal mining. It is dominated by emissions from upstream oil and gas activities.

Upstream oil and gas activities are defined to include all activities between the wellhead and the point of combustion and hence include transportation and distribution activities downstream of the gas processing plant or oil refinery. However, most of the fugitive emissions occur before the natural gas leaves the processing plant or the petroleum products leave the refinery. CO_2 is estimated to represent 7% by weight of the content of unprocessed natural gas, but this varies widely and can range up to 26%.[68] The CO_2 stripped from natural gas represents about one quarter of the total emissions in this category.

In summary, emissions between the wellhead and the gas processing plant or oil refinery are 7% of the national total, less stripped CO_2, less producer consumption at the processing plant/refinery, less fugitive emissions from the processing plant/refinery to the burner tip, less fugitive emissions from coal mining. The exact magnitude of these emissions is not known. The Multistakeholder Expert Group recommended implementing the program as close as possible to the wellhead and mine mouth to include as many of these emissions as possible. It should be feasible to implement the trading program at gas processing plants and oil refineries based on the carbon content of the input streams and at the mine mouth based on the composition of the coal produced.[69] Since the number of oil and gas wells is large (over 100,000) and the composition of the raw oil or gas stream varies, the feasibility of implementing a trading program at the wellhead needs further study.

Options for dealing with fossil fuel used as a non-energy feedstock are discussed in an NRTEE issue paper.[70] An upstream carbon content trading program raises the price of all fossil fuel products downstream of the gas processing plant or oil refinery. Price increases for feedstocks could adversely affect the competitiveness of petrochemical plants, especially if plants in other countries are not affected in the same way. The carbon in some petrochemical products is released to the atmosphere very quickly, while other products sequester the carbon for several decades.

National inventories of greenhouse gas emissions are prepared using methodologies developed by the Intergovernmental Panel on Climate Change (IPCC). Emissions are calculated on the basis of the production of different products. Products that sequester the carbon for at least 20 years are deemed not to create emissions. For products that release the carbon to the atmosphere within 20 years, the emissions are deemed to occur at the time of production. The country where the products are produced is responsible for the emissions even if the products are exported.

The Multistakeholder Expert Group recommended that petrochemical producers participate in the program in the same manner as exporters. Petrochemical products that sequester carbon for at least 20 years do not count as emissions. Producers could receive allowances for the carbon content of such products. They could be sold to organizations required to hold allowances under the trading program to offset the feedstock price increases.

Allowances for greenhouse gas emissions covered by the trading program could be sold at auction or be distributed *gratis*.[71]

The Multistakeholder Expert Group recommended that allowances be sold at auction and further analysis be undertaken of options for using the revenue.[72]

The upstream carbon content trading program would include elements normally associated with

both federal jurisdiction, such as international trade in fossil fuels, and provincial jurisdiction, such as production of fossil fuels. Issues arising from this jurisdictional dichotomy will have significant administrative and policy implications.[73]

Greenhouse Gas Emissions Coverage

Under this mandatory cap and trade program for most sources of greenhouse gas emissions, complemented by credit trading for sources and sinks not well suited to a cap and trade program, energy-related CO_2 emissions are covered by an upstream carbon content trading program for fossil fuel producers and importers. Most other sources of greenhouse gas emissions are also required to participate in the trading program. Sources that are not well suited to emissions trading and sinks would be allowed to create credits.

As discussed, it remains to be determined whether it is feasible to implement the trading program for the carbon content of fossil fuels at the wellhead or at gas processing plants and oil refineries. In the case of HFCs, SF_6 and PFCs (other than those from aluminum smelting), producers and importers of the gases would be required to participate in the trading program. Fertilizer manufacturers and importers would be responsible for the nitrogen used in fertilizers sold in Canada. For other sources covered by the trading program, the entity responsible for the emissions would participate. Allowances would be denominated in terms of CO_2 equivalents and emissions of other gases would be converted to CO_2 equivalents using internationally agreed global warming potential (GWP) values.

Energy-related CO_2 emissions account for most of Canada's total greenhouse gas emissions. As a result, there is some concern that the effect of the cap on greenhouse gas emissions in this design is to ration energy use in Canada. Any limit on Canada's greenhouse gas emissions will require measures to reduce energy-related CO_2 emissions because they are such a large share of the total. This emissions trading program design offers more flexibility than most other policy options in responding to the limit on greenhouse gas emissions.

The design caps total emissions by sources covered by the trading program; not energy-related CO_2 emissions; not CO_2 emissions from a particular fossil fuel; and not the energy-related CO_2 emissions of a particular company. Energy use could continue to increase if emissions by other sources are reduced by a larger percentage. Fossil fuel producers and importers can also purchase credits from other specified sources, such as landfills and sequestration, to augment the cap. Purchases under one or more of the international cooperative implementation mechanisms also raises the emissions allowed in Canada.

Energy users would face price increases for fossil fuels.[74] These price increases give them an incentive to increase energy efficiency, to conserve energy, and to switch to less carbon-intensive energy sources.[75] All energy users — industrial, commercial, residential and transportation — would face these price increases, and therefore have an incentive to reduce energy-related CO_2 emissions. The percentage price increases might differ due to taxes, the elasticity of demand for different products, and competition from other energy sources, so the impacts might differ by source category. Prices of products made with, or containing, other greenhouse gases covered by the trading program would rise for similar reasons.

Sources Required to Participate in the Program

Entities required to participate in the trading program would include: all fossil fuel producers and importers, large landfills, aluminum smelters, lime and cement producers, fertilizer manufacturers and importers, ammonia producers, magnesium smelters, nitric acid and adipic acid producers, and manufacturers and importers of HFCs, PFCs and SF_6. Fossil fuel exporters will need to participate by claiming credits for the carbon content of fossil fuels exported and

petrochemical plants will need to claim credits for the carbon sequestered in long-lived products.

Fossil fuel producers and importers include oil and gas producers, coal mines, oil sands plants, and importers of crude oil, refined petroleum products, natural gas and coal. A producer that exports fossil fuels or refined petroleum products could apply the allowances awarded for the exports against the allowances they are required to hold for production of the fossil fuel. Exporters that purchase Canadian fossil fuels or refined petroleum products for sale in another country could sell the allowances awarded for the exports.

Petrochemical plants might participate in the program in the same manner as exporters. Petrochemical products that sequester carbon for at least 20 years do not count as emissions. Producers could receive allowances for the carbon content of such products to offset the feedstock price increases.

Sources that are not well suited to emissions trading and sinks would be allowed to create credits. Credits could be earned for capture of emissions from small landfills, open pit mines, PFCs from aluminum smelting, and for carbon sequestration actions allowed by the international emissions limitation agreement.[76] It might also be possible to earn credits through actions to reduce livestock-related emissions from enteric fermentation or manure.

Number of Sources Involved

In total such a trading program would include approximately 500 to 1,000 participants. This is a manageable number for a trading program. The trading program would include 150 to 250 participants other than fossil fuel producers and importers. The minimum size of landfills required to participate in the trading program is the main determinant of the number of non-fossil fuel participants.

Most of the participants, 350 to 700, would be fossil fuel producers and importers. This includes oil and gas producers; coal mines; oil sands plants; importers of crude oil, refined petroleum products, natural gas and coal; exporters of crude oil, refined petroleum products, natural gas and coal; and petrochemical plants. The number depends on whether the trading program is implemented at gas processing plants and oil refineries or at the wellhead.

Production is already measured at the wellhead, in some collection pipelines, and at the refinery or gas processing plant. The composition of the crude oil and raw gas stream is also currently tested periodically. If the information currently collected is sufficient and sufficiently accurate to support a carbon content trading program at the wellhead, it would involve over 100,000 oil and gas wells. These wells are owned by approximately 600 firms, which would be required to participate in the trading program.

If the trading program cannot be implemented at the wellhead, it should be implemented at gas processing plants and oil refineries for the carbon content of the input streams. Application at the wellhead may not be feasible because the cost of testing the raw oil and gas streams at regular intervals to calculate the carbon content with sufficient accuracy is too high. Application at the wellhead also may not be feasible because of the extensive record-keeping required. If the trading program is implemented at gas processing plants and oil refineries, it would involve approximately 800 plants owned by about 180 companies.

Share of Total Emissions Covered by Participants

Virtually all greenhouse gas emissions except those due to livestock would be covered by this trading program design. Almost all fossil fuel CO_2 emissions would be covered by the fossil fuel producers and importers.[77] This includes all stationary and mobile source energy use, other than wood fuels. However, some of the upstream oil and gas and fugitive coal mining emissions are assumed to be outside the trading program. When the industrial sources covered by the program are included, the greenhouse gas emissions

covered amount to about 560 to 585 million CO_2 equivalent tonnes in 1995.[78] That represents over 90% of total national emissions.

Administering the Program

The Multistakeholder Expert Group recommended that the trading program be managed by a single agency. The process for developing the rules would probably be similar to that used for other environmental regulations. Stakeholders would have an opportunity to comment on the proposed rules before they are adopted.

The regulatory agency would:

- determine the monitoring requirements for different sources
- establish criteria and protocols for credit creation by different sources
- specify reporting programs
- verify that monitoring programs are functioning properly
- audit reported emissions
- enforce penalties for non-compliance
- conduct periodic auctions of allowances
- operate or contract for a registry

Some of those functions could be delegated or contracted to provincial or federal government agencies, such as the National Energy Board or the Alberta Energy and Utilities Board, or private sector entities.

The regulatory agency would need to develop rules for the trading program to cover items such as:

- *Allowance use and transfer* — sources required to hold allowances, entities allowed to hold allowances, rules for the distribution of allowances (*gratis* or auction), allowance life, banking, distribution of allowances to exporters and petrochemical plants, units of measurement.
- *Registry, reporting and monitoring* — monitoring requirements, reporting requirements, missing data protocols, notification requirements for transfers of allowances, price information, and public access to information in the registry.
- *Audit and verification* — authority of the regulatory agency to require information, order a third party audit, require annual reports, determine compliance, and administer prohibitions, restrictions and penalties.

The rules would be revised periodically based on experience with the program. The registry could be developed and operated by the appropriate government, cooperatively by the federal and provincial governments, or by a qualified organization under contract to the federal and provincial governments.

The Multistakeholder Expert Group made a number of recommendations for the initial program design. Those recommendations are summarized in Table 5.2.

The Multistakeholder Expert Group recommended that allowances be auctioned.[79] Sources required to hold allowances could purchase them at the auction. It is more likely that they will purchase the allowances they need from brokers who buy them at auction or from other sources.[80] More study is required on how best to conduct the auction and how to use the revenue raised by the auction.

Exporters of fossil fuels should be allowed to claim allowances for the carbon content of the fossil fuel products exported. The quantity exported should be available from shipping (pipeline, rail and ship) records and invoices. The carbon content of coal or crude oil exported can be obtained from tests already performed by independent laboratories for the buyers and the sellers. The carbon content of other products can be calculated from the product specifications.

Table 5.2
Key Design Issues and Proposed Choices to Address Them

Issue	Choice	Comments
Geographic Scope	• National program • Tied to international market	• Does not matter if other countries have different approach to emission reductions
Basket of Gases and Sources	• 100% coverage of all emissions from fossil fuels • 100% coverage of other GHG emissions from listed sources	• Upstream allowances on carbon content of crude oil, petroleum products, and coal • Allowance trading used for all sources marked "emission rights or substance trading" in Table 5.1 • Credit trading for landfills and ruminant CH_4 emissions
Creation of Competitive Market	• Allocation of permits through auction • With 500-1,000 sources, should not be a problem	• Concern whether sudden implementation of stringent emissions cap would limit supply of permits and hence competitiveness
Incorporation of All Programs into Single Market	• All allowances and credits in same units • GWP used to equate gases	
Metering and Testing for Carbon Content	• Use company records as first basis	• To prevent cheating: – cross-check company and buyer records – allow for external auditing
Liability — Seller or Buyer?	• Seller for allowances and credits after receiving government approval	• Those selling allowances pay penalty if they do not have enough left to cover their own emissions
Price Disclosure	• Automatic at auctions	
Transaction Costs	• Kept low by auction approach	• Could be complicated if credits from other systems are taken into account
Banking	• Post-2008 — yes • Pre-2008 through 2008 — maybe	• More analysis needed regarding continuing banking pre-2008 through 2008
Allowance or Credit Life	• Unlimited for now • Follow Kyoto rules	
Borrowing	• No	• Avoids problem of how to deal with companies that go out of business
Compliance Period	• One year	• Have 30- to 60-day grace period at end of accounting year to allow companies over their limit to buy what they need to comply
Penalties for Non-Compliance	• Loss of allowances equal to excess emissions plus financial penalties	
Allocation to New Sources/ Expansion of Program	• Allow new companies to participate in next auction	
GWP Values	• Yes — follow Kyoto	

Actions to reduce emissions of methane (CH_4) from small landfills, open pit mining, enteric fermentation, and animal manure, and PFCs from aluminum smelting should also be allowed to create credits. In these cases, credits should be issued if emitters reduce emissions below baseline levels. These baselines could be established using proxy activity data to estimate emissions. For example, one could use "quantity of waste" as a means to estimate landfill emissions; apply average emission factors to all beef and dairy cattle; and use models to calculate PFC emissions. Criteria for credit creation should be based on international rules. Under this program, credits would be interchangeable with allowances and could be sold for profit.

Measuring Emissions

The carbon content of fossil fuels produced, imported and exported would be calculated from the quantity of the fuel and analyses of its composition or an emissions factor as follows:

- Natural gas production — metered production by well and the most recent analysis of the composition of the output of the well. The regulatory authority should also have access to pipeline records, royalty payment calculations and supporting documents, and records of payments by gas processing plants to support the metered production. An analysis of the composition by an independent laboratory should be mandatory at appropriate intervals. The regulator should also have the authority to order an analysis of the composition by an independent laboratory.
- Oil production — metered production by well and the most recent analysis of the composition of the output of the well. The regulatory authority should also have access to pipeline records, royalty payment calculations and supporting documents, and records of purchases by oil refineries to support the metered production. An analysis of the composition by an independent laboratory should be mandatory at appropriate intervals. The regulator should also have the authority to order an analysis of the composition by an independent laboratory.
- Coal production — production by mine and the analyses of the composition of the coal during the period. The regulatory authority should also have access to railway records, royalty payment calculations and supporting documents, and records of purchases by customers to support the production records. Company analyses of the composition of the coal should be mandatory at appropriate intervals. The regulator should also have access to analyses performed by purchasers and have the authority to order analyses of the composition by an independent laboratory.
- Oil sands production — production by site and the analyses of the composition of the oil produced during the period. The regulatory authority should also have access to pipeline records, royalty payment calculations and supporting documents, and records of purchases by customers to support the production records. Company analyses of the composition of the oil produced should be mandatory at appropriate intervals. The regulator should also have the authority to order analyses of the composition by an independent laboratory.
- Natural gas imports and exports — documented quantities imported or exported multiplied by an emissions factor. The regulatory authority should also have access to pipeline records and records of purchases and sales to support the quantities reported. An appropriate emissions factor would be established by the regulatory authority. The regulator should also have the authority to order an analysis of the composition by an independent laboratory.
- Crude oil and petroleum product imports and exports — documented quantities imported or exported multiplied by an emissions factor specific to the product. The regulatory authority should also have access to pipeline and shipping company records and records of purchases and sales to support

the quantities reported. An appropriate emissions factor would be established by the regulatory authority for each product. The regulator should also have the authority to order an analysis of the composition by an independent laboratory.

- Coal imports and exports — documented quantities imported or exported and analyses of the composition of the coal imported or exported. The regulatory authority should also have access to railway and shipping company records and records of purchases and sales to support the quantity records. Purchaser and seller analyses of the composition of the coal would be used to determine the composition. The regulator should also have the authority to order analyses of the composition by an independent laboratory.

- Petrochemical plants would earn allowances for the carbon content of products that sequester carbon for at least 20 years. The number of allowances earned would be based on records of the quantities of eligible products produced and carbon content factors established by the regulatory authority. The regulatory authority would have access to other records to support the quantity data and have the authority to order analyses of the composition by an independent laboratory to supplement the emissions factors.

- Producers and importers of SF_6, HFCs and PFCs would be required to report the quantities of different products produced, imported and exported. The regulatory authority would adopt the internationally agreed Global Warming Potential (GWP) values as the emissions coefficients for these products. The regulator would have authority to audit the reports and other records to support the quantity data.

- Fertilizer manufacturers and importers would be required to report the quantities of different fertilizer products produced, imported and exported. The regulatory authority would establish N_2O emissions coefficients for the different types of fertilizers and use the agreed GWP value for N_2O to calculate the emissions associated with each product. The regulator would have authority to audit the reports and other records to support the quantity data.

- Aluminum smelters would calculate their CO_2 emissions by weighing the carbon anodes. The change in weight would be converted to CO_2 emissions. The reports of the change in weight would be supplemented by records on purchases of anodes and other records.

- Large landfills, adipic acid, nitric acid, ammonia, cement and lime plants and other sources covered by the trading program would be required to monitor their actual greenhouse gas emissions using monitoring devices specified by the regulator. The devices would need to be tested at intervals specified by the regulator. The regulator would also adopt missing data protocols to replace missing observations due to equipment failure, repair or other reasons.

Possible Complementary Policies

Complementary policies are discussed in more detail in an NRTEE issue paper.[81] A trading program for the carbon content of fossil fuels raises the prices of fossil fuels downstream of the sources required to hold allowances. Energy-related CO_2 emissions are actually reduced mainly by fossil fuel consumers who improve energy efficiency, reduce energy use, or switch to less carbon-intensive energy sources.

Complementary policies should help or encourage fossil fuel consumers to implement such measures. A wide range of complementary policies are possible, including:

- information programs on energy efficiency, energy conservation and fuel switching

- measures to stimulate development and commercialization of more energy-efficient technologies
- changes to the tax code to ensure that different energy sources receive comparable treatment.

Complementary policies can also be implemented to facilitate emission reductions from other sources. If large landfills and waste incinerators are part of the trading program but small landfills are not, other policies are needed to ensure that waste is not diverted to small landfills. Policies may also be able to encourage measures that reduce the use of SF_6, HFCs or PFCs in particular applications where suitable substitutes are available.

The method of distributing allowances may also give rise to complementary policies. If the allowances are auctioned as recommended by the Multistakeholder Expert Group, the revenue can be used to cushion the economic impacts on the groups most adversely affected, such as large energy consumers, coal mining companies, communities dependent on coal mines and energy-intensive industries, and individuals. *Gratis* distribution of allowances to fossil fuel producers and importers is likely to lead to windfall profits for such firms. Energy users, in contrast, bear higher energy prices and incur the costs of energy efficiency or fuel switching measures to reduce CO_2 emissions. Equity issues such as these will need to be addressed through the distribution of allowances or other policies.

Special Issues Raised by the Design

The main issue raised by an upstream trading program for the carbon content of fossil fuels is the treatment of petrochemical feedstocks.

The Multistakeholder Expert Group recommended that treatment of feedstocks follow Option 3 as outlined in the NRTEE issue paper on this topic.[82] This allows petrochemical plants to earn allowances equal to the carbon content of products that sequester carbon for at least 20 years. The carbon content of such products is considered to be sequestered and hence is not counted as part of the national emissions inventory. The carbon content of products with shorter lifetimes is considered to be emitted during the year in which the product is produced. Selling the allowances earned should enable the petrochemical producer to effectively offset the price increases due to the trading program for the feedstocks used in the long-lived products.

Transitional Issues Related to a Change in the Policy Setting

This option assumes that a national commitment to limit greenhouse gas emissions is in force. Participants will be expected to demonstrate compliance annually. If the allowances available during the first year are equal to 20% of the national commitment for the 2008-2012 period, the supply could be substantially below the actual emissions during the previous year. Since it is difficult to achieve large emission reductions in a short time, the price could be very high.

To avoid a disruptive introduction of the trading program, ways of phasing in the program need to be explored:

- The design of the trading program, including the allowance allocation rules, could be announced several years in advance of 2008 to enable the prospective participants to begin to adjust to the likely impacts. This approach might not work very well for this design because the trading program participants are fossil fuel producers and importers, while it is the energy consumers that must adjust their energy consumption patterns to reduce the associated emissions. Even given projection of the expected price impacts, consumers are unlikely to adjust their energy use until the prices actually change.
- Implementing the trading program before 2008 with an increasingly restrictive cap on emissions is one way to phase in the trading program and to generate the price signals needed to change energy consumption

behaviour. But doing this may create competitiveness problems for industry if other countries do not also start early.

- Another approach is to implement a declining cap on emissions during the 2008-2012 period. This does not create competitiveness problems if other countries do not begin to implement policies to limit greenhouse gas emissions prior to 2008. But it requires that the changes in energy consumption behaviour be achieved during the 2008-2012 period rather than over a longer period of time.

After the national commitment to limit greenhouse gas emissions has come into effect, it could become more stringent over time. Or the commitment could become less stringent, perhaps to the point that no restrictions on greenhouse gas emissions are needed.

If the commitment becomes more stringent, the cap on greenhouse gas emissions covered by the trading program would need to be made correspondingly more stringent to meet the revised commitment. If the commitment becomes less stringent, the cap on greenhouse gas emissions could be relaxed. As compliance with the relaxed cap became easier, the volume of trading activity and prices of allowances could be expected to fall.

VI. Downstream Greenhouse Gas Emissions Allowance Trading with VCT

Downstream Greenhouse Gas Emissions Allowance Trading with VCT Excluding Transportation — Description of the Program

This is a mandatory cap and allowance emissions trading program. It is assumed that it is implemented in response to Canada adopting a national commitment, such as the Kyoto Protocol, and then taking action to implement it.

Under this program, a regulated limit or cap is imposed on greenhouse gas emissions from a group of emitters. The regulator then issues allowances that provide a regulated emitter with the authority to emit a specific portion (e.g., one tonne) of the emissions allowed under the cap. At the end of each reporting period (e.g., one year), all emitters regulated under the program are required to hold allowances equivalent to their actual emission levels. Any emitters that have surplus allowances (or hold allowances but do not face a regulatory requirement) can sell these allowances to any emitter that is required to hold allowances but has actual emissions that exceed its allowance holdings.

This program imposes the requirement to hold allowances "downstream," at the level where emissions actually occur. It is also possible, however, to impose the requirement to hold allowances "upstream" (e.g., fossil fuel producers), and to regulate the substances that will ultimately produce emissions as opposed to the emissions themselves (see Chapter V, Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions). Under either program, there need not be a link between who is ultimately required to hold allowances and who actually receives allowances (through *gratis* allocation or auction) when the program enters into force.

At their meeting in September 1998, the NRTEE Multistakeholder Expert Group had a lengthy debate about the relative strengths and weaknesses of imposing the requirement to hold allowances either upstream or downstream.

If the requirement to hold allowances is imposed downstream, regulated emitters have a direct incentive to address greenhouse gas emissions because they face a regulated limit on those emissions. Nonetheless, if it is cheaper for a regulated emitter to buy allowances than reduce its own emissions, it will do so. On the other hand, if the requirement to hold allowances is imposed upstream, the incentive for emitters to reduce emissions will only be provided through the market. This will be because upstream producers will increase the price of greenhouse gas emitting products to encourage emitters to reduce the emissions associated with the use of these products.

A clear weakness of imposing the requirement to hold allowances downstream is that there are millions of sources of greenhouse gas emissions in Canada. It is administratively impossible to include all of these sources in an emissions trading program. As a result, an emissions trading program focused downstream sacrifices comprehensiveness.

This is clear in this program. It does require major point source users of fossil fuels (e.g., electric utilities, key industry sectors) to hold allowances equivalent to their emissions of greenhouse gases. The program also includes a number of non-energy sources of greenhouse gas emissions where there is some degree of comfort that emission levels can be accurately estimated or measured.

A number of key sectors, however, are excluded because they are characterized by a large number of small emitters. These include greenhouse gas emissions from the residential, commercial and road transportation sectors.[83] The administrative burden of enrolling these emission sources in the program is likely to be unmanageable.

As a result, this program imposes a requirement to hold allowances on emitters that account for only 44% of Canada's greenhouse gas emissions. This partial coverage has implications for the economic efficiency and equity of the program.[84] In essence, both are compromised unless complementary policies (e.g., regulations and taxes) are implemented to address sources not regulated under the emissions trading program. It is difficult, however, to design these complementary policies such that the marginal cost of greenhouse gas emission reductions will be the same between participants and non-participants in the emissions trading program.

This program, like all those examined by the NRTEE, does allow greenhouse gas sources and sinks not participating in the program to produce greenhouse gas emission reduction credits

through a voluntary credit trading program. These credits are denominated in the same units as emission allowances and are convertible into emission allowances. In fact, this program also allows participants to make use of credits and allowances generated by the Kyoto Protocol's flexibility mechanisms once they become operational.

This added flexibility ensures that the group of emitters regulated under this program have not had a greenhouse gas emissions quota imposed upon them. By obtaining greenhouse gas emission reduction credits from greenhouse gas sources and sinks not regulated under the program, the group of regulated emitters can increase their emissions above the cap or limit they face.

Incorporating a voluntary credit trading program into this program does increase the administrative burden (measurement, verification, enforcement) associated with the program. Moreover, the extent to which new and incremental emission reductions will be generated is difficult to predict.

Greenhouse Gas Emissions Coverage

This program is a downstream cap and allowance emissions trading program. It will regulate a significant portion of energy-related greenhouse gas emissions from the combustion of fossil fuels by requiring major point source users of fossil fuels as an energy source to participate in the program. The vast majority of energy-related greenhouse gas emissions are carbon dioxide, but methane and nitrous oxide emissions associated with fossil fuel combustion will also be included in the program through the use of internationally accepted Global Warming Potential (GWP) figures to convert these emissions into carbon dioxide equivalents.

The following sources of energy-related greenhouse gas emissions would be required to hold allowances equivalent to their emission levels under the program:

- electric utilities using thermal generation
- large industrial users of fossil fuels (petroleum producers and processors, pipeline companies, pulp and paper, iron and steel, smelting and refining, chemicals, cement, petroleum refining, and large-scale manufacturing)
- airlines and railways[85]

As noted earlier, the large number of small emitters of energy-related greenhouse gas emissions in the residential, commercial and transportation sectors are excluded from the program because of the administrative complexity their inclusion would engender.

The program will, however, extend beyond energy-related greenhouse gas emissions. Indeed, the following sources of non-energy-related greenhouse gas emissions would also be required to hold allowances equivalent to their emission levels under the program (once again, global warming potential figures would be used to calculate carbon dioxide equivalents):

- upstream oil and gas producers (fugitive CO_2 emissions)[86]
- large landfills (CH_4, CO_2)[87]
- adipic acid producers (N_20)
- aluminum smelters (CO_2, PFCs)
- lime and cement producers (CO_2)
- ammonia producers (CO_2)
- coal mining companies (CH_4)
- nitric acid producers (N_20)

To provide increased flexibility to participants in the program, it will be possible for many sources of greenhouse gas emissions that are not participating in the program to produce greenhouse gas emission reduction credits.[88] These credits should be in the same units as allowances and should be convertible. This would allow sources that create emission reduction credits to sell those credits to participants regulated under the

program who require additional allowances to meet their actual emission levels. Some of the activities that would be eligible to create credits under the program include:

- actions to reduce emissions from fossil fuel use in residential and commercial buildings as well as the small industrial and transportation sectors
- actions to reduce non-energy related emissions from sources like enteric fermentation and livestock manure
- actions to sequester carbon

It will be important to carefully define the greenhouse gas emission sources eligible to create credits to avoid the possibility of double counting. Clearly, sources that are regulated under the downstream cap and allowance emissions trading program will not be eligible to create credits.

Finally, it will also be possible for participants in the program to apply allowances or emission reduction credits obtained through the Kyoto Protocol's "flexibility" mechanisms (i.e., international emissions trading, joint implementation, and the clean development mechanism) against their emissions. At this time, the rules and operating procedures of these mechanisms are under negotiation. As a result, it is not yet clear what types of emission reducing activities will be covered by these programs.

Number of Participants and Their Share of Total Emissions

The number of participants in the program is determined by the "point of regulation."[89] In essence, the point of regulation defines what entities will be required to hold allowances equivalent to their emission levels. There are three potential points of regulation:

- individual emission sources within a facility or plant
- individual facilities or plants within a company
- individual companies

The number of emission sources covered by this trading program must be administratively manageable. While it is certainly necessary to measure and monitor greenhouse gas emissions at the individual source and facility level, it is not necessary to make this the point of regulation. In fact, this paper assumes that the point of regulation will be at the corporate level. Making this assumption minimizes the number of participants in the program and provides corporations with the flexibility to seek least cost emission reduction options across all of their facilities before having to enter the trading market.

Simply identifying the point of regulation as the corporation is not enough. It is also necessary to determine which corporations will participate in the program. Many of the sectors to be covered by this downstream cap and allowance emissions trading program include both small and large companies.

There are tens of thousands of companies that produce greenhouse gas emissions in Canada. It will not be possible to include all of them in this emissions trading program. Fortunately, most of Canada's industrial energy use and energy-related greenhouse gas emissions from industry occurs within seven industrial sectors, and most of the energy use within these sectors is concentrated within a small number of companies. Nonetheless, avoiding administrative impracticality will still probably require the establishment of a minimum annual emissions level (e.g., 100 kt of GHG emissions per year) beyond which it will be mandatory for a company to participate in the program.[90]

In this situation, there is a danger that firms regulated under the program will simply break into smaller units or that smaller companies will obtain an unfair competitive advantage because they fall outside the program. As a result, it is necessary to ensure that complementary policies are implemented that impose similar costs on all firms within a sector whether or not they are participating in the emissions trading program.

Table 6.1
Number of Participants and Emissions Covered by the Program

Participant Category	Total Sectoral Emissions[a]	Number of Program Participants[b]	% of Sectoral Emissions Covered[c]	Estimated Emissions Covered[d]	% of National Emissions[e]
Energy-related GHG Emissions					
Power Generation[f]	103,000	11	100	103,000	17
Upstream Petroleum[g]	55,800	600	80	44,640	7
Pulp and Paper	10,200	14	80	8,160	1
Iron and Steel	15,000	12	100	15,000	2
Smelting and Refining	2,800	10	80	2,240	
Chemicals	7,600	30	80	6,100	1
Petroleum Refineries	2,100	13	100	2,100	
Cement Production	3,700	5	80	2,960	
Other Industry	35,600	200	55	19,580	3
Airlines + Railways	16,780	4	100	16,780	3
Non-Energy-related GHG Emissions					
Upstream Petroleum[h]	47,350	n/a	22	10,600	2
Landfills[i]	18,250	120	65	11,860	2
Adipic Acid Production	10,850	1	100	10,850	2
Aluminum Smelting	9,600	11	100	9,600	2
Lime and Cement[j]	7,630	40	80	5,890	1
Ammonia	3,800	10	100	3,800	1
Coal Mining	1,700	28	80	1,360	
Nitric Acid Production	930	9	100	930	
Total	**352,690**	**1,118**	**78**	**275,450**	**44**

[a] 1995 GHG emissions in kilotonnes of CO_2 equivalent, from Environment Canada's *Trends in Canada's Greenhouse Gas Emissions (1990-1995)* (detailed tables in Appendix A-2), unless otherwise noted.

[b] These figures are preliminary estimates of the number of participants that would be expected to participate in the program, given the threshold levels discussed in the text. They have been drawn from a variety of sources, including: industry associations, VCR submissions, and Statistics Canada, and need to be further confirmed and refined

[c] Estimates of portions of sectoral emissions that would be covered by program participants.

[d] Sectoral emissions multiplied by estimated percent that would be covered by these programs.

[e] Estimated emissions covered as a percent of total national GHG emissions.

[f] Emissions in this row include predominantly power generation by utilities, but also power generation by industrial companies. The companies in this row are utilities only. The industrial companies are listed by sector, along with GHG emissions that are not from power generation.

[g] This row addresses oil and gas producers and pipelines.

[h] It is assumed that fugitive methane emissions are not included in the program. The number of participating companies has already been included under energy-related emissions.

[i] It is assumed that only large landfills (more than 2 million tonnes of waste) participate in the program.

[j] The number of potential participants does not include the major energy-using cement manufacturers identified above.

As Table 6.1 illustrates, the number of participants is large enough to ensure a competitive market, but small enough to ensure the program is manageable and administratively feasible. Indeed, the United States' SO_2 emissions trading program will involve significantly more participants as of the year 2000.

Table 6.1 also illustrates, however, that coverage of emissions under the program is limited. Sources accounting for less than half of Canada's greenhouse gas emissions (44%) will be regulated under this program. This makes consideration of complementary policies for sources not participating in the program a necessity if Canada hopes to meet a binding emission reduction commitment.

Allowing sources not covered under the program to engage in emission reduction credit trading could potentially increase both the number of participants and the percentage of Canada's emissions covered by an emissions trading framework. It is unlikely, however, that the emissions trading program will provide a strong enough incentive for voluntary emission reduction credit creation so that the result would significantly increase the coverage provided.

Administering the Program

This paper does not address the issue of which government jurisdiction should have responsibility for implementing a downstream domestic cap and allowance emissions trading program for greenhouse gases. Canada's Constitution provides no clear guidance in this regard. It is clear, however, that at this time any level of government seeking to establish a domestic emissions trading program for greenhouse gases would need to pass new legislation to obtain all the authority required.[91]

Setting out the rules governing this emissions trading program will be a time-consuming process that will likely require the participation of all relevant stakeholders, including both federal and provincial governments. A full discussion of the range of administrative issues that must be addressed in either an allowance or credit trading program can also be found in an NRTEE issue paper.[92] Some of the rules that will need to be developed concern:

- allowance use and transfer (who needs allowances, who can hold allowances, how to distribute allowances, what are the units of measurement, banking and borrowing?)
- registration, reporting and monitoring (what are monitoring and reporting requirements, what information is public or confidential)
- audit and verification (who determines compliance, role of third party audits, power to acquire information, administration of penalties in cases of non-compliance)

The addition of a voluntary credit trading program will require the development of an additional set of rules. These rules will have to address issues such as: baseline establishment, liability, criteria for credit creation, and the role of life-cycle emissions accounting in the program. These issues have already been discussed in the extended description of Voluntary Credit Trading in Chapter III.

While there are a number of design issues that need to be addressed to make Downstream GHG Emissions Allowance Trading operational, the key issue concerns how allowances will be allocated to participants. At their meetings in September 1998 and January 1999, the NRTEE Multistakeholder Expert Group discussed this issue and reached the following conclusions:

- Initially, allowances should be distributed *gratis* to all participants.[93] It was agreed that this would help to compensate holders of capital stock that see that stock devalued with the establishment of limits on greenhouse gas emissions under an emissions trading system. The allocation formula will have to include a mechanism to provide allowances to new participants that enter the system over time (e.g., some allowances could be set aside for this purpose).

- It was also agreed, however, that over time there will be a decreasing need to compensate emitters for devalued capital stock as capital stock turns over. Accordingly, it was agreed that there should be a gradual transition over time to an auction of allowances for participants in the system. Determining the length of this transition and its extent (what percentage of total allowances will ultimately be auctioned) requires further study.

The NRTEE Multistakeholder Expert Group was unable to address in detail most other issues related to the administration of this emissions trading program at their meetings. As a result, Table 6.2 proposes potential responses to some of the key design issues raised in the relevant NRTEE issue paper to flesh out this program design.

Table 6.2
Key Design Issues and Proposed Responses

Design Issue	Potential Response
Holders of Allowances	Any entity can hold allowances (e.g., they can be purchased by an environmental group and be retired).
Allowance Unit of Measurement	One tonne of carbon dioxide equivalent.
Banking and Borrowing of Allowances	Banking for future use should be allowed, but borrowing from hypothetical future allowances should not.
Allowance Life	Throughout the period covered by Canada's binding emission reduction commitment(s).
Price Disclosure	Through brokers.
Compliance Period	One year with a grace period at the end of the year (60 days) to allow participants to come into compliance.
Liability and Penalties for Non-Compliance	The seller is liable and the buyer need not worry about transactions being invalidated. If by selling allowances a seller ends up not having enough allowances to cover its emissions at the end of the compliance period, it will have to purchase new allowances to come into compliance and pay a stiff fine.[a]

[a] The NRTEE Issue Paper *Analysis of Emissions Trading Program Design Features* notes that all existing domestic allowance trading programs impose liability on the seller.

Measuring Emissions

It is essential to be able to accurately measure actual emission levels in a downstream cap and allowance emissions trading program. There are several different ways to measure and/or estimate actual emissions and it is likely that a mix of these methods will be required to ensure that all participants are meaningfully engaged in the program. These measurement options include:

- Continuous Emissions Monitoring (CEM) through sophisticated tamper-proof devices. This may well be an effective measurement tool at large point sources of emissions like coal-fired electricity generating stations.
- Tamper-proof fuel meters could be used to monitor fuel use and then standard conversion factors could be used to calculate greenhouse gas emissions.[94] This might be more appropriate for smaller sources of energy-related greenhouse gas emissions.[95]
- In some cases, it may be difficult to measure actual emission levels or any factor that has a clear and well-understood direct relationship to emission levels. Under these circumstances, the regulator may be forced to develop a standard "model" that emitters can use to estimate emission levels on the basis of other data (e.g., production levels, type of equipment used). Clearly, these estimates will be less accurate than estimates and measurements derived through the methods outlined above. It will be up to the regulator to determine if such "models" provide estimates that are accurate enough to justify inclusion of a source in the emissions trading system.

The trading program rules will need to specify the type of monitoring equipment each source is required to install, test procedures to ensure that it is operating accurately, and also specify protocols for emissions estimation in the event of missing data for all sources. Missing data protocols should be designed to bias the estimates upward so that participants have an incentive to keep their monitoring equipment operating properly. Where modelling is required to estimate emissions,

the trading program rules will have to clearly specify the protocols to be used and ensure that they are used consistently by all sources. It is likely that sources would be subject to periodic verification audits by the government authority or a third party.

The measurement protocols established can have a major impact on program design. For example, this program requires petroleum refineries to be responsible for the greenhouse gas emissions generated through their combustion of fossil fuels on site. If these emissions are measured through fuel use meters instead of continuous emission monitors, some problems could arise. This is because petroleum refineries use fossil fuels as non-energy feedstocks in the production of other goods that sequester the carbon contained in the feedstocks. Under this scenario, petroleum refiners would need to be allowed to create emission reduction credits for the carbon sequestered for 20 years or more in the products produced.[96] This issue does not arise, however, if measurement occurs through continuous emissions monitoring.

Adding domestic credit trading to the program poses additional measurement challenges. An emission reduction credit is equal to the difference between actual emissions and baseline emission levels. A baseline can either be estimated (i.e., what would have happened if a specific emission reduction action had not taken place) or regulated. To have confidence that emission reduction credits represent real emission reductions requires that: (a) actual emissions of credit generators can be measured with a high degree of confidence, and (b) accurate baseline levels can be established for credit generators.

Actual emission levels can be determined through the use of tools like those described above. In a credit trading program where baselines are determined by regulations such as performance standards (Mandatory Performance Standards with VCT), it is also straightforward to determine baseline levels. It is likely, however, that the credits traded under the downstream GHG emissions allowance trading program would be created without the benefit of a regulated baseline. As a result, estimating baseline levels becomes much more complicated. This is because there is an inherent difficulty in assessing "what would have happened" and this becomes more problematic as time passes and other factors influence events.

If credits are awarded for emission reductions that are not "additional" (i.e., they would have happened anyway), the participant purchasing that credit is allowed to increase emissions even though no real incremental emission reduction has occurred. As a result, that participant is simply passing on the responsibility for generating real emission reductions to other participants in the program, creating real equity and efficiency concerns.[97]

Possible Complementary Policies

An emissions trading program is one of several measures to address greenhouse gas emissions. Complementary policies will often be required to remove barriers to the implementation of greenhouse gas emission reduction measures for emitters regulated under the program, and to ensure that emitters outside the program also take steps to reduce greenhouse gas emissions.[98]

With regard to this specific program, there is clearly room for the implementation of complementary policies that remove barriers to the implementation of greenhouse gas emission reductions for emitters regulated under the program. While it is true that regulated emitters will receive a price signal that encourages emission reduction under this program, it is also true that a number of barriers exist that will prevent emitters from adopting the most cost-effective emission reduction options in response to this price signal.

Some examples of such barriers include: institutional barriers (e.g., institutional cultures), information barriers (e.g., a lack of information about greenhouse gas emission reduction opportunities), and financial barriers (e.g., lack

of access to capital). These barriers threaten the economic efficiency of the emissions trading program.

Implementation of complementary policies that help to overcome these barriers will improve the economic efficiency of an emissions trading program. Some examples of such policies include: utiltity demand-side management programs, information and education programs, energy audits, procurement programs, and the removal of subsidies.

The partial coverage offered by this emissions trading program — as mentioned, it will only regulate emitters responsible for 44% of Canada's greenhouse gas emissions — threatens both the environmental and economic benefits of implementing an emissions trading program.

The environmental benefits are threatened because incomplete coverage raises the possibility of "leakage" — emissions simply being transferred from participants in the program to emission sources not covered by the program. For example, if some companies in a sector are regulated under the program and others are not, non-regulated companies could gain a competitive advantage in the marketplace, increasing their emissions.

The economic benefits are threatened because an emissions trading program is designed to equalize the marginal cost of emission reductions across the program. If emission sources outside the program are not receiving the same price signal, and different sectors are regulated with different stringency, the result could be price distortions across sectors that ultimately make it more costly to achieve an environmental objective.

Sources of greenhouse gas emissions outside the emissions trading program can be addressed principally through regulations or standards and taxes. The use of taxes provides the best opportunity to ensure that the marginal cost of emission reductions is equalized between participants in the program and non-participants. At the same time, however, it is important to try to ensure that participants in the emissions trading program do not face a "double burden" in the form of a regulated requirement to hold allowances and a tax. The number of participants in this program is relatively small. It should be possible to exempt them from a tax imposed on non-participants in the program.

There is also an important role for the use of regulations (e.g., energy efficiency standards for appliances, equipment, buildings and vehicles) in addressing emissions from sources not included in the emissions trading program. It is difficult, however, to ensure that the price signal generated by these regulatory changes is consistent with that produced by the emissions trading program.

Transitional Issues Related to a Change in the Policy Setting

As noted earlier, this program is described as being implemented in a policy context where a national commitment, such as the Kyoto Protocol, has entered into force, and where Canada will be required to implement policies to reduce greenhouse gas emissions. The downstream cap and allowance emissions trading program serves as the mechanism through which Canada has allocated responsibility for a portion of its climate protection commitment to specific sources.

If such a binding commitment is subsequently abandoned, it would be unlikely that Canada would continue its mandatory cap and allowance emissions trading program.

In reality, however, Canada has signed the Kyoto Protocol and there is a prospect that it will enter into force, although this is not guaranteed. Once again, with no mandatory commitment in place for Canada under the Kyoto Protocol, it is unlikely that this program will be put into place.

On the other hand, suddenly implementing a program like this one when a binding commitment is undertaken could impose serious economic costs if steps have not been taken by program participants to reduce their emissions

in preceding years to close to the level of allowances that will be available. There are several steps that could be undertaken to ease this transition:

- A voluntary credit trading program with meaningful incentives could be established to encourage learning about emissions trading and to generate some emission reductions.
- Regulators could inform participants that a program will be put in place at a specific future date and could provide participants with the rules that will govern the program at that time.
- A voluntary pilot program could be established among companies that have made voluntary commitments to limit their emissions to a specific level to provide a learning opportunity for potential program participants and regulators. As the allocation issue would not need to be addressed, the pilot could focus on the mechanics of a cap and allowance trading program. This would include issues related to measurement, reporting, verification and trading.
- A wide range of other policies (e.g., regulations or taxes) could be implemented to provide a strong incentive for potential participants to begin to take action to reduce their emissions.
- A mandatory cap and allowance emissions trading program with less stringent emission caps could be established prior to the "commitment period" to provide an opportunity for program participants and regulators to familiarize themselves with the program.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT and Upstream Carbon Content Trading for Transportation Fuels — Description of the Program

This is a mandatory cap and allowance trading program. Again, the program is assumed to be implemented in response to Canada adopting a national commitment, such as the Kyoto Protocol, and then taking action to implement it.

Unlike the preceding program, this proposed domestic emissions trading program is not exclusively applied "downstream," at the level where greenhouse gas emissions actually occur. This is because this program attempts to incorporate most transportation-related greenhouse gas emissions. Such an effort is clearly valuable, as transportation accounted for 27% of Canada's greenhouse gas emissions in 1995.[99]

At their meeting in September 1998, the NRTEE Multistakeholder Expert Group spent a significant amount of time discussing whether or not emissions trading had any role to play in controlling Canada's transportation-related greenhouse gas emissions. It was agreed that it would be difficult to address the transportation sector through an emissions trading program that required emitters to hold allowances equal to emission levels because the transportation sector is characterized by a massive number of small emitters. Under such a situation, the administrative burden required to operate the program may outweigh any economic efficiency gains, particularly if individual consumers are unwilling or unable to participate actively in emissions trading.[100]

As a result, the preceding program assumed that transportation-related emissions would primarily be dealt with through complementary policies (e.g., gasoline taxes or fuel efficiency standards

for new automobiles) or through the creation of emission reduction credits within a voluntary credit trading program.

This program takes a different tack. There is a clear and strong link between the carbon content of transportation fuels and greenhouse gas emissions. For example, the carbon content of gasoline is such that every litre of gasoline burned in Canada will produce 2.36 kg of carbon dioxide emissions. It is therefore possible to accurately measure and control greenhouse gas emissions in the transportation sector by measuring and controlling the carbon content of transportation fuels.

Accordingly, this program builds on the preceding one by adding an "upstream" component to the emissions trading program. It does this through petroleum refiners and importers of transportation fuels. As significant energy users, petroleum refiners already participated in the preceding program and were required to hold allowances equivalent to their own actual emission levels.

This program, however, also requires petroleum refiners to hold allowances for the greenhouse gas emissions that will be produced from the combustion of the transportation fuels they sell in Canada.[101,102] This approach is an "upstream" approach because petroleum refiners are being held responsible for transportation-related emissions, even though their activities do not actually produce these emissions. Importers of transportation fuels, who are not controlled under the preceding program, would also be required to participate in this program.

As a result, this is a hybrid program. A limit or cap is established on total emissions from a group of emitters and the regulator issues allowances that allow an emitter to emit a portion of the emissions allowed under the cap. Most of the participants in the program are required to hold allowances equivalent to their actual emission levels, but petroleum refiners and importers of transportation fuels are also required to hold allowances equivalent to the carbon content of the transportation fuels they sell in Canada.

Petroleum refiners would receive credits for the carbon content of transportation fuels that are exported. Once again, regulated sources with surplus allowances (or non-regulated sources that have obtained allowances) can sell these allowances to regulated sources whose emissions exceed their allowance holdings.

The incorporation of transportation-related emissions through the addition of upstream carbon content trading can dramatically increase the coverage of the emissions trading program. Instead of covering only 44% of Canada's greenhouse gas emissions, this program would cover 67% of Canada's emissions. Moreover, this increased coverage can be achieved with fewer than 50 new participants (producers and importers of transportation fuels) entering the program.

Nonetheless, some members of the NRTEE Multistakeholder Expert Group expressed strong reservations about addressing the transportation sector in this way. This concern was based on the fact that petroleum refiners and importers of transportation fuels can, on their own, do little to reduce greenhouse gas emissions from the transportation sector. In fact, these companies can primarily reduce these emissions by increasing the price of transportation fuels to consumers. Consumers then have a much broader range of strategies available to reduce greenhouse gas emissions from transportation.[103]

Two key questions were raised in the NRTEE Multistakeholder Expert Group about this outcome:

- Does it make more sense to send this price signal through emissions trading or to directly implement a price change through the levy of a tax?
- Is a price signal the most effective way to reduce greenhouse gas emissions in the transportation sector or are other policies required?

With regard to the first question, if the level of the price signal is the same in both cases, there should be no difference in the economic efficiency

between use of a tax and use of an upstream carbon content trading program. More work is needed, however, to assess the relative administrative burdens and political feasibility of each option. In reality though, it would be difficult to determine the level at which a tax should be established to match that which would have been generated through incorporation in the emissions trading program. As a result, it is less likely that the marginal cost of emission reductions would be equal across sectors, decreasing economic efficiency within society as a whole.

With regard to the second question, there is a great deal of debate about the extent to which consumers will respond to changes in the price of transportation fuels. If demand for these fuels is highly inelastic, huge increases in price will be required to decrease demand for these fuels. Under these circumstances, it may be more cost effective to use complementary policies (e.g., fuel efficiency standards for auto manufacturers) to bring about emission reductions in the transportation sector.

The implementation of this domestic emissions trading program, however, is not designed to reduce emissions in the transportation sector specifically. Rather, it is meant to ensure that emissions are reduced where it is most cost effective to do so among the emitters regulated under the program. If demand for transportation fuels is highly inelastic, it simply means that the price signal generated by the program will more readily produce emission reductions in other sectors than in the transportation sector. Total emissions will still not exceed the amount regulated by the program.

Greenhouse Gas Emissions Coverage

This program builds on the preceding one by incorporating transportation-related greenhouse gas emissions directly into the trading program. Specifically, this addresses greenhouse gas emissions associated with the combustion of transportation fuels in automobiles and light- and heavy-duty trucks and brings them into the emissions trading program.

While the preceding program addressed transportation-related GHG emissions from airlines and railways by requiring these entities to hold allowances equivalent to their actual GHG emissions, continuing this approach in this program would mean that different transportation-related emission sources were not treated equally. Accordingly, in this program, petroleum refiners and importers of transportation fuels will be held responsible for the carbon content of transportation fuels used by airlines and railways for travel within Canada.[104]

Number of Participants and Their Share of Total Emissions

It was estimated that the preceding program would involve 1,118 participants. This program adds virtually no new participants to the domestic emissions trading program. Indeed, the only new participants in the program would be importers of refined petroleum products (transportation fuels) that distributed these fuels for use in Canada. According to the extended description of Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions (Chapter V), there are only 15 to 50 companies in Canada that import coal, natural gas or petroleum products that are not domestic fossil fuel producers. As a result, the addition of an upstream carbon content trading program for transportation fuels does not significantly increase the number of participants beyond what was envisioned in the preceding program.

There is, however, a much more important difference between the two programs. Specifically, this program covers significantly more of Canada's greenhouse gas emissions. While the preceding program addressed only 44% of Canada's greenhouse gas emissions, the addition of an upstream carbon content trading program for transportation fuels allows cap and allowance trading to address 67% of Canada's greenhouse

gas emissions.[105,106] This should increase the economic efficiency of the emissions trading program, lowering costs for society as a whole.

Administering the Program

The extended description of the preceding program discusses in some detail key administrative issues associated with a cap and allowance emissions trading program. Many of these administrative issues would not need to be handled any differently with the addition of an upstream carbon content trading program for transportation fuels. This is not, however, universally true.

For example, it is not clear that the *gratis* distribution of allowances described in the preceding program would be appropriate for petroleum refiners and importers of transportation fuels that are required to hold allowances for the carbon content of transportation fuels they sell in Canada. While requiring these firms to hold allowances for the carbon content of the transportation fuels they sell in Canada may reduce the value of the capital stock that produces these fuels, this reduced value will be rapidly offset by the value of the allowances distributed *gratis*. At the same time, however, the main tool these firms have to reduce emissions and their need for allowances is to increase the price of transportation fuels for consumers.[107] This produces windfall profits for these firms because they are able to increase the price at which they sell their product without seeing a corresponding increase in the cost of producing their product.

The NRTEE Multistakeholder Expert Group discussed this issue and agreed that more study was required to determine: (a) the extent to which devaluation of capital stock is an issue in this sector, and (b) the extent to which petroleum refiners can pass on costs to customers and collect windfall profits.[108] It was agreed that governments could either auction allowances or impose a tax to eliminate windfall profits. Nonetheless, it is clear that more study is required. If windfall profits are not an issue, it was agreed that a *gratis* allocation of allowances was preferred. As a result, it is likely that this program, like the preceding one, would begin with some *gratis* allocation of allowances but would gradually make a transition to an auction of allowances over time.

While there are examples of emissions trading programs where the vast majority of allowances are distributed *gratis* and a small percentage are subsequently auctioned, there is no system where both allocation systems account for a substantial portion of the total allowances distributed. If windfall profits are a significant issue, however, 35% of the total allowances distributed would need to be auctioned to petroleum refiners to cover potential emissions from the carbon content of the transportation fuels they sold in Canada. Can such a hybrid program be made to work?

The answer is probably yes. An initial set of allowances would be distributed *gratis* to all emitters participating in the program. A subsequent auction of the remaining allowances, restricted to petroleum refiners and importers of refined petroleum products (transportation fuels), would be held. More work is required to consider the mechanics of such an auction and what would be done with the revenues raised.

Measuring Emissions

It is essential to be able to accurately measure actual emission levels in a cap and allowance trading program. The inclusion of upstream carbon content trading in the transportation sector should not pose a significant challenge.

Under such a program, petroleum refineries and importers of transportation fuels would need to provide documented records of the sale of their products. These quantities could then be multiplied by emission factors to provide a fairly accurate estimate of total emissions.

Import records and sales records (domestic and export) are not difficult to produce and can be verified by the regulator. Moreover, transportation fuels are made to specifications that should leave little doubt about their carbon content

and, as a result, it should be relatively straightforward for a regulator to develop an emission factor. The regulator should also retain the ability to test the carbon content of transportation fuels sold.

Possible Complementary Policies

An emissions trading program is one of several measures to address greenhouse gas emissions. Complementary policies will often be required to remove barriers to the implementation of greenhouse gas emission reduction measures, and to ensure that sources outside the program also take steps to reduce greenhouse gas emissions.

As noted earlier, the NRTEE Multistakeholder Expert Group discussed the potential role emissions trading could play in reducing emissions from the transportation sector. Once again, it must be noted that the emissions trading program discussed here is not designed specifically to reduce greenhouse gas emissions from the transportation sector. It is designed to reduce emissions in the most cost-effective way across all sectors regulated under the program. The contribution of the transportation sector to total emission reductions will depend on the degree to which cost-effective opportunities are available in the sector and the responsiveness of emitters (drivers) to the price signals generated by the program. There is no consensus on the price elasticity of gasoline.[109]

If the main objective of Canada's climate change policy was simply to reduce greenhouse gas emissions from the transportation sector, however, a cost-effective response would likely require a mix of policies (i.e., regulatory, fiscal, information) if gasoline was highly price inelastic.

Of course, as in the preceding program, a range of complementary policies will also be required to address emission sources not covered under the cap and allowance trading program.

Appendix 1: Possible Designs for a Domestic Emissions Trading Program for Greenhouse Gases — NRTEE Working Paper

Purpose

This document is intended to provide information to help the Multistakeholder Expert Group on Domestic Emissions Trading guide the analysis of options for a domestic emissions trading program for greenhouse gases.

Specifically, this document includes:

- a long list of possible designs for a domestic emissions trading program for greenhouse gases
- a recommended short list of designs for further analysis, with arguments supporting the selection
- an outline of the proposed content of extended descriptions of the options selected for further analysis
- a list of issues common to multiple design options
- a recommended short list of issues to be analyzed together with supporting arguments

The analysis of possible designs for a domestic emissions trading program for greenhouse gases by the National Round Table on the Environment and the Economy (NRTEE) is intended to provide information on this possible option to the national advisory Issues Tables and other processes that will contribute to the development of the Canadian strategy to respond to the Kyoto Protocol.

Process

The analysis is expected to proceed in two stages. The process is outlined below:

Stage 1:

- Further study of a short list of possible designs for a domestic emissions trading program, for example, a voluntary credit trading program; and
- Further study of a series of issues common to multiple designs, for example, analysis of options for *gratis* distribution of allowances.

This work is expected to be completed in September, following a meeting of the Mulitstakeholder Expert Group at which time detailed designs for a domestic emissions trading program will be developed by fleshing out the framework designs with detailed assumptions relating to common issues.

Stage 2:

- The detailed designs will be used to analyze issues such as the administrative requirements and economic effects of different designs.

The analysis of the detailed designs is expected to be completed in the spring of 1999.

Possible Designs for a Domestic Emissions Trading Program

Before listing possible designs it is necessary to define alternative policy settings for a domestic emissions trading program. Three policy settings are distinguished:

- The prospect of a future commitment to limit greenhouse gas emissions exists. Canada has signed the Kyoto Protocol. As a result, the prospect of a future commitment to limit greenhouse gas emissions exists at the present time.
- The prospect of a national commitment to limit greenhouse gas emissions no longer exists. This would be the case if the Kyoto Protocol does not come into force.[110]
- A commitment to limit greenhouse gas emissions exists and policies to meet that commitment are being implemented. This would be the case if Canada ratifies the Kyoto Protocol, the Protocol comes into force, and policies are implemented in Canada to meet that commitment prior to and/or during the commitment period.[111]

Table A1.1
Summary of Possible Designs and Recommended Short List

Design	Short List	Description
Prospect of Future Commitment to Limit GHG Emissions		
1	✔	Voluntary credit trading
2		Voluntary cap and trade system
No Specific Prospect of a Commitment to Limit GHG Emissions		
3		Voluntary credit trading
Commitment to Limit GHG Emissions Exists		
4	✔	Cap on carbon content of fossil fuels produced and imported with trading by producers, importers and exporters
5		Cap on carbon content of fossil fuels crossing provincial and international borders, with trading by owners of the fuels
6		Cap on the carbon content of fossil fuels implemented at the narrowest point in the distribution chain, with trading by owners of the fuels
7		Voluntary credit trading
8	✔	Voluntary credit trading with mandatory performance standards
9		Mandatory credit trading
10		Voluntary cap and trade system
11	✔	Cap on emissions by fossil fuel users, trading by large fuel users and oil companies for transportation fuels
12		Same as previous option, but excluding transportation sector
13	✔	Same as option 11 but with no opportunity to purchase credits or allowances from sequestration or sources outside the program
14	✔	Cap on emissions by fossil fuel users, trading by large fuel users and municipalities for transportation and commercial/residential buildings

Summary of Possible Designs and Recommended Short List

A total of 14 possible designs are identified, of which six are recommended for further analysis. These designs are summarized in Table A1.1.

The Prospect of a Future Commitment to Limit Greenhouse Gas Emissions Exists

This is the current situation — Canada and a number of other countries have signed the Kyoto Protocol, which includes commitments to limit greenhouse gas emissions during the period 2008 through 2012.[112] As a result, the prospect of a future commitment to limit greenhouse gas emissions exists at the present time.

In this situation emissions trading may be motivated by a desire to gain experience with emissions trading or a policy that provides credit for early action.

- If emissions trading is a possible policy option to meet the future commitment, sources may wish to gain experience with emissions trading. Sources have an incentive to begin to reduce their emissions to be better able to meet the potential future commitment.[113] But emissions trading also requires a motivation on the part

of some entities to purchase emissions reductions implemented by other sources. In this situation the motivation to buy emissions reductions must be voluntary. Voluntary purchases of emissions reductions could be motivated by belief of a need for action, by a desire to enhance the corporate image, to meet a voluntary target such as a commitment under the Voluntary Challenge and Registry, or to attempt to forestall a future commitment or regulation.

- A program of credit for early action should eliminate any risk that early emission reductions might lead to more onerous commitments and may provide positive incentives for such actions. Credit for early action improves the business case for actions to reduce emissions and so should increase the volume of early emission reductions. And if the early reductions can be credited toward future commitments, more sources may be willing to buy credits.[114]

Two options for emissions trading are possible in this setting — voluntary credit trading or a voluntary cap and trade system.

Option 1

In a voluntary credit trading program some sources create "credits" by documenting emissions reductions they have implemented and other entities voluntarily purchase some of these credits. Governments encourage such activity by providing appropriate assurances or incentives; for example, that the credits created or purchased can be used to meet existing voluntary or potential future regulatory obligations. Such a trading program would be equivalent to full-scale implementation of the GERT and PERT pilot programs in Canada and the "project-based" stream of the NESCAUM demonstration program in the United States.[115]

Option 2

Under a voluntary "cap and trade" system, some sources would voluntarily agree to limits on their aggregate emissions as part of a pilot program. Sources whose emissions were growing more rapidly than anticipated or whose costs of reducing emissions internally were higher than expected could purchase surplus "allowances" from other participants.

A voluntary cap and trade system can be implemented relatively easily by affiliated companies, such as those in the BP Group, because the financial transfers are internal to the group. One of two streams of the NESCAUM demonstration project is attempting to better understand the strategic and decision-making implications for companies that have adopted a voluntary cap on their greenhouse gas emissions. Companies that have submitted voluntary emissions limits to the Voluntary Challenge and Registry could use those limits as their allowance allocations for a voluntary cap and trade system.[116]

No Specific Prospect of a National Commitment to Limit Greenhouse Gas Emissions Exists

If the Kyoto Protocol does not come into force, Canada would not have a national commitment to limit greenhouse gas emissions.

Emissions trading requires a motivation on the part of some entities to purchase emissions reductions implemented by other sources. If there is no specific prospect of a national commitment to limit greenhouse gas emissions, the motivation to buy emissions reductions must be voluntary. Voluntary purchases of emissions reductions could be motivated by belief of a need for action, by a desire to enhance the corporate image, to meet a voluntary target such as a commitment under the VCR, or to meet conditions for exporting to countries that have adopted their own greenhouse gas emissions limitation commitments.

Option 3

The only trading option possible in this setting is a voluntary credit trading program. Some sources create "credits" by documenting emissions reductions they have implemented and other

entities voluntarily purchase some of these credits. This option is identical to option 1, except that the policy setting provides a weaker incentive to purchase credits.

Commitment to Limit Greenhouse Gas Emissions Exists and Policies to Meet That Commitment Are Being Implemented

In this situation, sources of greenhouse gas emissions are subject to policies that require them to limit their emissions. It is assumed that policies are implemented that, directly or indirectly, limit emissions from virtually every source of greenhouse gases. Some, but probably not all, sources are required or allowed to participate in domestic emissions trading.[117] Sources outside the trading program are assumed to be subject to other policies, such as efficiency standards, taxes, controls on products, etc. These other policies are not specified as part of the options.

The trading program design options specified below are described for energy-related CO_2 emissions. It is assumed that other sources and sinks of greenhouse gases would be incorporated into these options where feasible and appropriate. Accordingly, if any non-energy related CO_2 emission sources or sinks can be readily incorporated into any of these allowance or credit trading designs, it should be assumed that they are included. This has not been done here because more work is required to determine which sources and sinks lend themselves to emissions trading and which form of trading is most appropriate in each case (see Issue 1).

It is assumed, as well, that international cooperative implementation mechanisms are available under all of the options and that the frameworks agreed internationally will allow participants in Canada's domestic trading program to use any of these options. The Kyoto Protocol establishes three cooperative implementation mechanisms — emissions trading among Annex I Parties (developed countries), joint implementation among Annex I Parties, and emission reductions in developing countries certified through the Clean Development Mechanism.[118] Canada could participate in all three mechanisms. Each can be used to increase the emissions allowed in Canada while still meeting the commitment under the Protocol.

Option 4

Fossil fuel producers, importers and exporters are included in a carbon content trading program. Each producer and importer must hold allowances equal to the carbon content of the crude oil, natural gas, coal, and imported petroleum products sold. Exporters receive allowances equal to the carbon content of the crude oil, natural gas, coal and petroleum products exported.

This design is implemented as far "upstream" as possible. Participants in the trading program are companies that produce, import or export oil, natural gas, coal, or petroleum products. A cap is imposed on the CO_2 equivalent emissions by these firms from the carbon content of the products they sell in Canada.[119] Sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program. Participants may also purchase credits from other specified sources, such as landfills and sequestration, to augment the cap.[120] Increasing the emissions allowed in Canada through one or more of the international cooperative implementation mechanisms can also raise the cap.

This option is assumed to be implemented cooperatively by the federal and provincial governments since the former has jurisdiction over foreign trade while the provinces have jurisdiction over production of fossil fuels. Implementation details, whether implemented at the wellhead or at gas processing plants and oil refineries, for example, remain to be defined. Treatment of the fuel used as feedstock also needs further analysis.

Option 5

A trading program is established for the carbon content of fossil fuel transported across provincial or national boundaries. The owner of crude oil, natural gas, coal and petroleum products

shipped across provincial or national boundaries must hold allowances equal to the carbon content of the fuel. Exporters receive allowances equal to the carbon content of the crude oil, natural gas, coal or petroleum products exported.

A cap is imposed on the carbon content of the fossil fuel shipped by participants. Again it is assumed that sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program. And it is assumed that purchasing credits from other specified sources or through one or more of the international cooperative implementation mechanisms could augment the cap. Treatment of the fuel used as feedstock in this option needs further analysis.

This is similar to option 4 except that it excludes fossil fuel produced and consumed within a province. This consists mainly of coal used by electric utilities but also includes some oil and gas in producing provinces. The amount of coal, oil and gas consumed in producing provinces could be substantial, since it includes most coal used to generate electricity, fuel use and losses in gas processing plants, fuel use and losses in several oil refineries, and fuel used as feedstock for a number of petrochemical plants. Thus, the share of total energy-related CO_2 emissions covered by the trading program is lower than for option 4. But, the assumption that all sources bear a fair share of the burden means that these emissions would be covered by other policies.

It is assumed that this trading program could be implemented and administered by the federal government alone, while option 4 is assumed to involve cooperative implementation by the federal and provincial governments. However, provincial governments would need to implement policies to regulate the emissions associated with energy produced and consumed within the province under this option.

Option 6

The carbon content of fossil fuel is regulated at the narrowest point in the distribution chain to minimize the number of participants in the trading program. This is likely to be the mines or preparation plants for coal, refineries for oil, and processing plants or pipelines for natural gas. The design must ensure that imports of crude oil, natural gas, coal and petroleum products are covered while exports of those products are excluded. Again, the participants in the program would be required to hold allowances equal to the carbon content of the fuel purchased or sold.

In practice this option could be very similar to option 4 or 5 because those options might choose some of the same control points for administrative reasons.[121] As with the other options, sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program, and the cap established for participants could be augmented through international trade or purchases of credits from other domestic sources. How to deal with fuel used as feedstock also needs further analysis.

Option 7

To have a voluntary credit trading program in the context of a national emissions reduction commitment, governments would need to accept industry assurances that they will achieve emissions reductions equal to their fair share of the national commitment and allow industry to establish a voluntary credit trading program to achieve the reductions at least cost. To ensure that Canada met its national commitment, governments would presumably insist that if the voluntary program did not meet its commitments participants would be subject to mandatory emission reduction measures and possibly penalties. Otherwise failure of the voluntary program to achieve the agreed reductions imposes an unfair burden on other sources.

Industry sources participating in the voluntary credit trading program would presumably have targets reflecting their contribution to the national commitment.[122] Sources that reduced their emissions below their target could create credits. Sources that found it costly to meet their target internally could purchase credits. Credits or allowances could also be purchased from domestic programs for non-energy emissions, or through international cooperative mechanisms.

The voluntary credit trading program would cover energy-related CO_2 emissions. Other greenhouse gas emissions could be controlled by emissions (allowance or credit) trading programs. Thus, credits or allowances from other domestic sources and gases or from the international cooperative mechanisms could be used by program participants as well. The treatment of feedstocks is not affected by the trading system in this option.

Option 8

Governments could implement a series of mandatory performance standards, such as energy efficiency standards, to limit emissions and allow voluntary credit trading to reduce the cost of complying with the standards. The performance standards are assumed to be defined per unit of output (or input), for example, CO_2 equivalent emissions per tonne of steel, per automobile, or per kWh produced. Sources able to reduce their emissions below the level specified by the standard are able to create credits. Sources that found direct compliance with the standard costly could comply by purchasing credits instead.

The performance standards are not emissions caps because they are defined on the basis of a unit of output or input. Total allowable emissions would change as actual output (or input) changed. Governments would need to adjust the performance standards to ensure that actual emissions are less than the national commitment. The performance standards facilitate credit trading by helping to define baselines for credit creation. To provide an incentive to purchase credits, the regulations would need to be written to allow sources to use credits to comply with the performance standards.

The voluntary credit trading program with mandatory performance standards would cover energy-related CO_2 emissions. Other greenhouse gas emissions could be controlled by emissions (allowance or credit) trading programs. Thus, credits or allowances from other domestic sources and gases or from the international cooperative mechanisms could be used by program participants as well.

Option 9

With mandatory credit trading each participant would have a government-established annual limit on its greenhouse gas emissions. It would be required to monitor and report its actual emissions. Actual emissions would need to be below the established limit to achieve compliance. Sources whose actual emissions are below their allowed levels could create credits by documenting their achievements. The credits could be sold to help other sources meet their assigned limits.

This option is similar to option 7 except that the targets for individual participants are mandatory. This option is also similar to a cap and trade system, except that participants do not receive allowances. Instead, they must document their reductions to create credits and obtain regulatory approval for the credits before they can be traded. Mandatory credit trading could be applied to fossil fuel producers, importers and exporters in lieu of the cap and trade system proposed in options 4, 5 or 6, or to fossil fuel users in lieu of the cap and trade system proposed in options 11, 12, 13 or 14.

The caps established for participants could be augmented through international trade or purchases of credits from specified domestic sources outside the mandatory trading program, such as landfills and sequestration.

Option 10

A voluntary "cap and trade" system is also possible given a national commitment to limit greenhouse gas emissions. Governments could accept industry assurances that they will achieve emissions reductions equal to their fair share of the national emissions reduction commitment and allow industry to establish a voluntary cap and trade program to achieve the reductions at least cost.

Industry sources, individual firms and possibly industry associations that provided such assurances would presumably have voluntarily established an aggregate target reflecting their contribution to the national commitment.[123] Participants would need to agree on individual allocations, monitoring, reporting and verification requirements, and penalties for non-compliance. The provisions for monitoring, reporting and verification would need to meet government-established minimum standards. Participants could then trade in the same manner as in a government operated trading system.

The voluntary cap and trade program would cover energy-related CO_2 emissions. Other greenhouse gas emissions could be controlled by emissions trading programs. Thus, the cap established for participants could be augmented through international trade or purchases of allowances or credits from other domestic sources. How to deal with feedstocks would need further analysis and could depend on the sources that participate in the trading program.

Option 11

A cap and trade system is established for energy-related CO_2 emissions by fossil fuel users. Participants would include electric utilities and large industrial sources. Large commercial and institutional buildings and medium-sized industrial plants could also be included. Large airlines and railways would participate. Motor vehicle emissions could be covered by including refineries or gasoline retailers. Governments would set a cap on total energy-related CO_2 emissions by participants.[124] Each participant would be required to hold allowances equal to its actual CO_2 emissions.

The total number of participants would probably be much larger under this option than under options 4, 5 and 6. To keep the number of participants small enough for effective administration this option might be reduced to cover only large sources — electric utilities, large industry, large transportation companies, and producers of gasoline and diesel fuel.

Implementation of this option might involve provincial administration of fixed sources — industry, electric utilities, and commercial and institutional buildings with federal administration of the transportation sector and federal buildings. As with the other options in this section, sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program, and the cap established for participants could be augmented through international trade or purchases of credits from specified domestic sources.

Option 12

This option is the same as option 11, except that the transportation sector is excluded. Thus, this option is a cap and trade system for electric utilities and large industrial sources, with large commercial and institutional buildings and medium-sized industrial plants included if this does not create administrative difficulties.

The reason for excluding the transportation sector from the trading system is that transportation sector emissions are difficult to accommodate in a cap and trade system. Transportation sector emissions would be regulated by other means.

As with the other options in this section, sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program, and the cap established for participants could be augmented through international trade or purchases of credits from other domestic sources.

Option 13

This option is the same as option 11, except that trading is restricted to the participants. No purchases of credits from other domestic sources are allowed, but purchases through the international cooperative mechanisms are possible. Participants would include electric utilities, large industrial sources, large airlines, railways, and refineries or gasoline retailers. Large commercial and institutional buildings and medium-sized industrial plants would also be included unless the administrative requirements became unwieldy.

The reason for excluding purchases of credits from other domestic sources is to better understand the administrative complexities and economic efficiency added by merging a credit trading option with the basic cap and trade system.

Option 14

This option also establishes a cap and trade system for CO_2 emissions by fossil fuel users, but extends the range of sources covered. As in options 11, 12 and 13, electric utilities, large industrial sources, large airlines and railways would participate directly. The federal and provincial governments would participate directly as managers of government buildings. Municipalities would have caps covering the emissions from residential and commercial buildings and urban transportation.

This option would probably involve more participants than options 11, 12 and 13, but it covers residential and commercial buildings, which are not captured in those options. To keep the number of participants in this option manageable, small municipalities would probably be excluded. Electric and gas utilities, or other groups, could earn credits by implementing energy efficiency and fuel switching options in residential, commercial and small industrial buildings in municipalities that are not part of the trading program.

As with the other options in this section, sources of other greenhouse gas emissions amenable to allowance trading also participate in the trading program, and the cap established for participants could be augmented through international trade or purchases of credits from specified domestic sources.

Combinations of Options

Combinations of some of the above options are possible: a voluntary cap and trade system for some sectors and a cap and trade system for other energy-related CO_2 emissions. The reason for defining the designs listed above is to select some of the options for further study. Combining options is desirable only if it leads to a better result than any of the individual designs on its own. Until the strengths and weaknesses of the specific options are better understood, it is not possible to define combinations that achieve this result.

Recommended Short List of Designs for Further Analysis

The design options recommended for further analysis are 1, 4, 8 11, 13 and 14.

- Option 1 is a voluntary credit trading program assuming only the prospect of a future commitment to limit greenhouse gas emissions. Such a trading program would be similar to the GERT, PERT and NESCAUM pilot programs and should be analyzed in cooperation with participants in those pilots to maximize efficiency and limit duplication of effort.

- Option 4 is a trading program for the carbon content of fossil fuels and petroleum products that involves fossil fuel producers, importers and exporters. It would provide virtually complete coverage of energy-related CO_2 emissions with a relatively small number of participants.

- Option 8 is a voluntary credit trading program with mandatory performance standards to ensure the national emissions commitment is met. The performance standards are assumed

to be expressed in terms of emissions per unit of output (or input) and so allow a firm's emissions to vary with output.

- Options 11 and 13 apply to energy-related CO_2 emissions by electric utilities, large industrial sources, large airlines, railways, and refineries or gasoline retailers. Large commercial and institutional buildings and medium-sized industrial plants might also be included. The only difference is that in option 13 trading is restricted to the participants; no purchases of credits or allowances from other domestic sources are allowed.
- Option 14 also establishes a cap and trade system for CO_2 emissions by fossil fuel users, but distributes responsibility for the various users differently than options 11 and 13. They differ in two ways: the approach to motor vehicle emissions (about 20% of total emissions), and inclusion of residential and small commercial sources in option 14.

Option 2 is not recommended for further analysis because credit trading is more likely than a cap and trade program in this policy setting as evidenced by the GERT, PERT and NESCAUM pilot projects. The issues related to a cap and trade system that arise when such a system is voluntary also arise when the trading system is mandatory. Hence, the issues raised by option 2 will be analyzed under options 4, 11, 13 and 14 but in a different policy setting.

Option 3 is not recommended for further analysis because it is essentially the same as option 1 but for a different policy setting. The policy setting for option 1 is currently more relevant and would lead to more trading than the policy setting for option 3. However, part of the analysis of each option on the short list will be issues related to transition to different policy settings. Thus, the analysis of transitional issues for option 1 will address, in part, options 3 and 7.

Options 5 and 6 are not recommended for further study because they are essentially the same as option 4, which is being studied. The share of total emissions covered by options 5 and 6 is likely to be smaller than that covered by option 4. However, if subsequent analysis of jurisdictional issues indicates that option 4 would be difficult to implement, options 5 or 6 could be considered as a substitute.

Option 7 is not recommended for further analysis because it is similar to option 1, which is being recommended. The analysis of transitional issues for option 1 will address, in part, option 7. In addition, option 8, which is being studied, also addresses many of the issues that would arise in option 7.

Option 9 is not recommended for further analysis because the key design issues that highlight the differences between credit trading and allowance trading systems will already be covered by other options in the proposed short list. In addition, this option is very similar to a cap and trade system.

Option 10 is not recommended for further analysis because issues related to a cap and trade system that arise when such a system is voluntary also arise when the trading system is mandatory. Hence, the issues raised by option 10 will be analyzed under options 4, 11, 13 and 14, although some of those issues would be resolved by industry participants, rather than governments, under option 10.

Option 12 is not recommended for further analysis because it is the same as option 11, which is being recommended, except for exclusion of the transportation sector. If the analysis of option 11 encounters difficulties in accommodating the transportation sector, this would become the default option.

Proposed Content of Extended Descriptions of the Options Selected for Further Analysis

Once a short list of emissions trading program designs has been agreed upon, each option will be described in more detail. The descriptions are expected to include:

- the emissions covered by the trading program
- the sources required to participate in the program
- the number of sources involved
- share of total emissions covered by participants
- how the trading program would be administered
- how emissions would be measured
- possible complementary policies, such as efficiency standards
- any special issues raised by the design, such as treatment of feedstocks
- transitional issues related to a change in the policy setting
- issues related to potential future changes in the national commitment (for options 4, 8, 11, 13 and 14 only)
- evaluation of the option using the criteria listed in Table A1.2

Table A1.2
Criteria for Evaluating Proposed Greenhouse Gas Emissions Trading Systems

Economic efficiency	
	Cost effectiveness
	Transactions costs
	Comprehensiveness
Equity	
	International equity
	Domestic equity
	Industrial equity
Technical feasibility	
	Technical flexibility
	Timing
	Leakage
Political feasibility	
	Domestic political compatibility
	International compatibility
	Sovereignty
Administrative feasibility	
	Measurability
	Verifiability
	Enforceability

These criteria are drawn from *Analysis of the Potential for a Greenhouse Gas Trading System for North America*, Commission for Environmental Cooperation, Montreal, May 1997, Chapter 3, pp. 32-42, and are described there.

Issues Common to Multiple Options

A number of issues are common to several designs and hence can be analyzed separately while the design options are being further developed. These issues identified and those recommended for further analysis are listed in Table A1.3.

Each of the issues is described briefly below. Further work on an issue is recommended unless a reason to the contrary is given.

Issue 1. Determination of the type(s) of emissions trading system suitable for each source/gas covered by the national commitment. The national commitment in the Kyoto Protocol covers anthropogenic greenhouse gas emissions from energy production and use, landfills, adipic acid, lime production, cement production, nitric acid production, aluminum production, magnesium production, fertilizer use, HFC uses, PFC uses, SF_6 uses, methane emissions from livestock, methane emissions from manure, and methane emissions from wastewater treatment. Net changes in emissions due to direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation, can be used to meet the commitment if rules can be agreed upon. Parties may also agree on rules for governing activities to sequester carbon in other sinks, such as agricultural soils. The analysis required is to determine which of these sources/gases lend themselves to which form(s) of emissions trading. If more than one type of trading system is possible for a given source/gas, the best option should be determined based on considerations such as number of participants, share of emissions covered, ease of monitoring, potential for leakage, etc.

Table A1.3
Issues Common to Multiple Options and Recommendations for Further Study

Issue	Further Study	Deferred	Description
1	✔		Determination of the type(s) of emissions trading system suitable for each greenhouse gas source or sink
2	✔		Analysis of legislative authority to implement different forms of emissions trading for various sources and sinks
3			Methods to link the domestic emissions trading system to the provisions of the Kyoto Protocol
4	✔		Implications of international trade agreements for design of a domestic emissions trading program
5	✔		Options for treatment of fossil fuels used as feedstocks
6	✔		Analysis of options for *gratis* allocation of allowances to participants in a domestic emissions trading program
7	✔		Analysis of options for distributing allowances by auction
8	✔		Analysis of emissions trading program design features
9	✔		Specification of criteria for credit creation where credit trading is accepted
10	✔		Analysis of implications of using life-cycle emissions in trading system designs
11	✔		Evaluation of possible complementary policies
12		✔	Assessment of the administrative resources needed to implement emissions trading for greenhouse gases
13		✔	Evaluation of the need to regulate the allowance/credit market
14		✔	Analysis of the economic effects of different emissions trading systems compared with a regulatory regime
15		✔	Analysis of the ancillary environmental benefits of the anticipated greenhouse gas emissions reductions
16		✔	Analysis of potential market power

Issue 2. Analysis of legislative authority to implement different forms of emissions trading covering various sources and sinks of greenhouse gases. Some provinces have legislation that explicitly authorizes emissions trading, but other provinces and the federal government do not have such legislation in place. The consistency of the legislation, where it exists, and the legislative requirements to implement various design options need to be examined.

Issue 3. Methods to link the domestic emissions trading system to the provisions of the Kyoto Protocol. (This is relevant only to options that assume the Protocol is ratified and adopted by Canada.) The domestic emissions trading program would need to be consistent with measurement and reporting obligations under the Protocol. The domestic emissions trading program would also need to be linked to the cooperative implementation mechanisms — international emissions trading, joint implementation, and the clean development mechanism — established by the Protocol. This issue is not recommended for further work because it will be addressed by the Emissions Trading Issue Table.

Issue 4. Implications of international trade agreements for design of a domestic emissions trading program. In general trade agreements require that imports be accorded the same treatment as domestic products. How that principle, or other more specific requirements, are implemented in a domestic emissions trading program could affect the design of the program. The potential for adverse competitiveness impacts, leakage, frivolous unfair trade practices complaints, and retaliatory actions needs to be considered.

Issue 5. Options for treatment of fossil fuels used as feedstocks. Petroleum and natural gas products are used as feedstocks in the production of a very wide range of products, including petrochemicals. The cost of the feedstock is generally a significant share of the total cost. Any policy that has the effect of increasing the cost of the feedstock — carbon tax, emissions trading for the carbon content of fossil fuels, regulations on energy-related CO_2 emissions, etc. — will have a significant impact on the cost of producing these products. Some of the products, such as asphalt, sequester carbon for a very long time, while others decay and release the carbon to the atmosphere within a few years. What options are available to reasonably balance the environmental impacts of these products and the economic impact of greenhouse gas policies on the industry?

Issue 6. Analysis of options for gratis *allocation of allowances to participants in a domestic emissions trading program.* Every cap and trade program implemented to date in the United States has distributed allowances free of charge to participants. But each has used a different allocation rule. While the details of the allocation rule need to be specific to the design option chosen, it is useful to analyze the principles involved and their implications. The work on this issue will clarify the principles involved in *gratis* allocation of allowances and their implications. It will specifically address the treatment of new, expanding and declining sources under *gratis* allocation of allowances. Allowance allocation rules will be compared with the distribution of emission rights implicitly established by credit trading programs.

Emissions trading makes it possible to separate responsibility for limiting emissions from the implementation of emission reduction actions. The possibility of allocating allowances, in whole or in part, to persons or entities not required to hold allowances to cover their actual emissions will also be discussed. Such allocations could be designed to address competitiveness, compensation, or adjustment issues.

Issue 7. Analysis of options for distributing allowances by auction. Reasonable arguments can be made for use of an auction or transition from *gratis* allocation to an auction as a means of distributing allowances for greenhouse gases. The design of the auction can affect the outcome and the perceived equity. Thus, an analysis of options for distributing allowances by auction, including the impact of the auction design on prices and options for the use of the revenue raised is needed.

Issue 8. Analysis of emissions trading program design features. The design features of an emissions trading program include: emissions monitoring, reporting, audit and verification, permit life, banking, borrowing, price disclosure, trading institutions, operation of the registry, transactions costs, fees, penalties for non-compliance, legal liability for allowance/credit validity, participation of new sources, allocation of allowances to sources that cease to operate, changes to the emissions cap as international commitments change, etc. All of these issues need to be decided before an emissions trading program to meet regulatory requirements can be implemented. In most cases, the principles involved are the same regardless of the specific program design, so it makes sense to analyze them independently.

Issue 9. Specification of criteria for credit creation where credit trading is accepted. Sources not covered by a cap and trade program are assumed to be subject to other policies that limit their emissions. Some of those sources will be able to create credits by reducing their emissions beyond the levels required. In general, such sources should be allowed to create credits for sale to other sources or to purchase credits for compliance with their obligations if that is less costly. That raises questions of criteria for credit creation and use, which in turn may influence the way regulations are structured. The scope for credit trading also needs to be defined for each design to avoid double counting. In option 14, for example, credits created by a utility that implements energy efficiency measures in buildings within a participating municipality lead to double counting.

Issue 10. Analysis of implications of using life-cycle emissions in trading system designs. Emissions trading systems generally deal with actual emissions by participants. To address "upstream" emissions, firms involved in production, processing and transportation of energy must also participate in the trading program or be subject to other policies governing their emissions. Making participants in the trading system responsible for the life-cycle emissions, rather than their direct emissions, might allow the overall regulatory structure to be simplified. This issue paper will analyze the implications of using life-cycle emissions as the basis for different credit and allowance trading design options.

Issue 11. Evaluation of possible complementary policies. Complementary policies are measures that enhance the efficiency, effectiveness or equity of the selected emissions trading program as a domestic policy to achieve the national commitment. They could include policies to facilitate credit creation and use by sources and sinks outside the trading program; policies such as efficiency standards for buildings, vehicles, appliances and equipment, to reduce barriers to achievement of greater energy efficiency; or policies to assist adjustment in industries and communities affected by the domestic policy to achieve the national greenhouse gas commitment.

Issue 12. Assessment of the administrative resources needed to implement emissions trading for greenhouse gases. To implement an allowance trading system, regulators need to verify that reported emissions are accurate. This involves periodic testing and inspection of monitoring equipment, quality control on reported emissions, and implementation of missing data procedures as required. If a "buyer beware" approach is adopted for credit trading, regulators do not become involved until a participant proposes to use credits for compliance. A registry that tracks ownership of allowances and credits is required. This can be operated by the regulator or by an independent agency.

In an allowance trading system, the regulator determines compliance by comparing verified actual emissions with allowance holdings for each source. In a credit trading system, the regulator verifies that credits used to achieve compliance meet the established criteria. Enforcement action is then taken against sources not in compliance. The federal and provincial governments need information on the administrative resources required to perform these functions under allowance- and credit-based

systems. It is recommended that further work on this issue be deferred until detailed emissions trading options have been developed and are being evaluated.

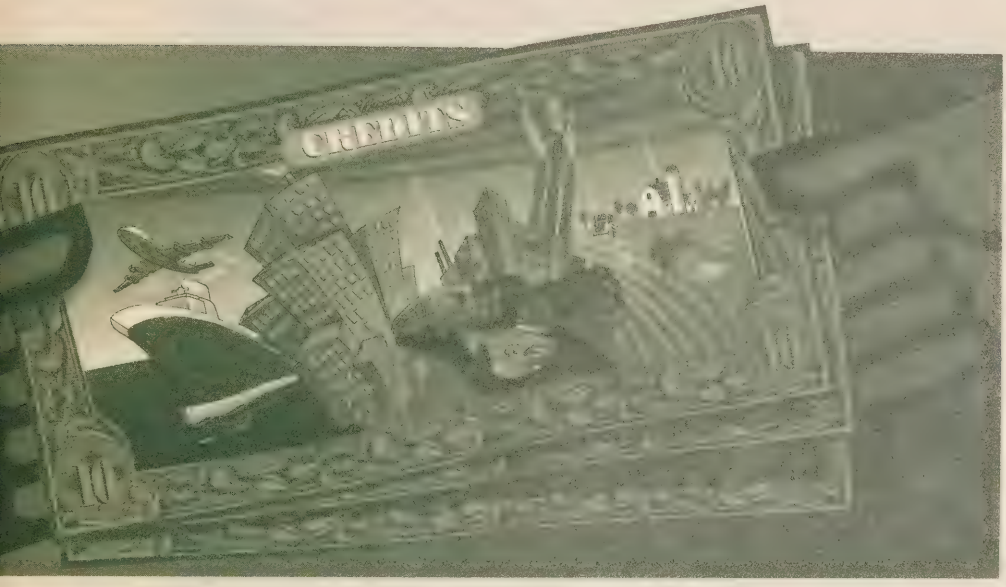
Issue 13. Evaluation of the need to regulate the allowance/credit market and how best to meet that need. The financial aspects of emissions trading programs in the United States have not been regulated. The allowances are not listed on a stock or commodity exchange. Brokers help to match buyers and sellers, but the brokers are not regulated. Regulation of the financial aspects of the trading programs has been considered unnecessary since the participants are large companies which should be able to protect their own interests. An emissions trading market for greenhouse gases might be much larger or involve less sophisticated participants so that some regulation of the market is desirable. It is recommended that further work on this issue also be deferred until detailed emissions trading options have been developed and are being evaluated.

Issue 14. Analysis of the economic effects of different emissions trading systems compared with a regulatory regime to meet the same commitment. Such an analysis can only be completed after the emissions trading designs have been well specified. The economic effects should include both domestic effects on production and consumption of various goods and services and the international effects on trade and financial flows. This requires specification of the international context, including the adoption of greenhouse gas emissions commitments by Canada's major trading partners. That provides a basis for assessing the impacts of alternative policy options on the competitiveness of different industries. Options for addressing these impacts should then be considered. The options could range from adjusting the policies to reduce the competitive impacts to assisting affected industries and communities to adjust to the impacts. Since the analysis can only be performed after the detailed emissions trading options have been developed, it is recommended that further work on this issue be deferred until that time.

Issue 15. Analysis of the ancillary environmental benefits of the anticipated greenhouse gas emissions reductions. Many measures that reduce greenhouse gas emissions also reduce emissions of other pollutants. Lower emissions of these other pollutants may have human health or environmental benefits. Lower emissions of other pollutants may also reduce spending to control the emissions of those pollutants. These ancillary benefits of limiting greenhouse gas emissions vary with the location of the emissions reductions. Thus, it is not possible to analyze the ancillary benefits of a proposed trading system until the option has been modelled. Hence analysis of the ancillary benefits is deferred until detailed emissions trading options have been developed and are being evaluated.

Issue 16. Analysis of potential market power. An emissions trading system requires that a competitive market be established if it is to function efficiently. If the number of participants in the market is small, or if a few of the participants control a substantial share of the allowances or credits bought or sold, those participants may be able to wield market power — to influence prices higher or lower to their advantage. The potential for market power can not be analyzed until the proposed trading system is well defined and so is deferred until detailed emissions trading options have been developed and are being evaluated.

Appendix 2: Descriptions of Selected Existing Emissions Trading Programs



Voluntary Credit Trading (VCT)

Pilot Emission Reduction Trading (PERT)

The Pilot Emission Reduction Trading (PERT) project is a demonstration project established in 1996 to:

- evaluate the environmental and economic benefits of using emissions reduction credit trading as a tool to improve air quality in the Windsor-Quebec corridor
- examine the compatibility of credit trading with the regulatory framework in Ontario
- identify and resolve stakeholder concerns with trading program design elements
- design a trading system for Ontario and bordering airsheds that is acceptable, is easy to use, and can be integrated with other trading systems

PERT is a self-funded, non-profit organization. It is managed by a multistakeholder Working Group and supervised by an Executive Committee. Large industrial organizations, governments, consultants and smaller organizations contribute financially to the operations of the Working Group. Health and environmental organizations participate voluntarily and are provided limited reimbursement for travel and other expenses.

The PERT Working Group and its various task teams develop an annual work plan, recruit new members, develop communications and other outreach activities, review credit creation and use protocols, and work with governments and others to promote emissions reduction credit trading as a strategy for air pollutant emissions reduction.

The primary focus of the PERT project is NOx and VOC emissions in southern Ontario.

However, participants are requested to track changes in emissions of all pollutants as a result of actions under PERT. A summary of the credit creations, trades, uses and retirements posted to the registry through 1997 is presented in Table A2.1.[125] The data reflect approximately 10 credit creation actions, most of which last several years. A few participants have implemented more than one credit creation action, so the data reflect the actions of 5 to 10 companies. Many of the credit creation actions by PERT participants had not yet been listed with the registry and so are not reflected in the data in Table A2.1.[126]

All of the trades and uses registered represent purchases by one participant to help meet a voluntary commitment. Most of the credits created were banked (held as balances) in anticipation of agreement on a letter of understanding with the provincial Ministry of the Environment. The letter of understanding, signed in July 1998, enables actions under the pilot project to be used to meet potential future regulatory obligations. Specifically,

> [i]n the event the project does not lead to a trading program, all emission reductions created or transacted in the project will be recognized as early progress towards future requirements or regulations or towards all self-imposed commitments. If the project leads to a trading program, all emission reductions created or transacted by corporate participants in the project will be subject to the rules of that program.

Although the primary focus of the PERT project is NOx and VOC emissions, CO_2 accounts for most of the reductions achieved to date.[127] This simply reflects the fact that most sources of NOx or VOC emissions are also sources of much larger quantities of CO_2 emissions. So actions to reduce NOx or VOC emissions often lead to much larger reductions of CO_2 emissions as well.[128]

Table A2.1
PERT Creation, Trading, Retirement and Use Summary Report

(tonnes)

Pollutant/Year	1994	1995	1996	1997	Totals
CO Created			38	38	76
CO Traded			38	38	76
CO Retired			4	4	8
CO Used					
CO Balance			34	34	68
# CO Creations			1	1	2
NOx Created	397	2,651	4,660	6,252	13,960
NOx Traded[a]		334	1,007[a]	2	1,343[a]
NOx Retired	40	321	573	540	1,474
NOx Used		111	214		325
NOx Balance	357	2,219	4,236	5,712	12,524
# NOx Creations	1	6	7	4	18
CO_2 Created	128,167	284,936	363,757	326,044	1,102,904
CO_2 Traded					
CO_2 Retired	12,817	28,494	36,376	32,604	110,291
CO_2 Used					
CO_2 Balance	115,350	256,442	327,381	293,440	992,613
# CO_2 Creations	3	4	4	1	12
SO_2 Created	867	1,363	1,708	1,829	5,767
SO_2 Traded					
SO_2 Retired	87	136	171	183	577
SO_2 Used					
SO_2 Balance	780	1,227	1,537	1,646	5,190
# SO_2 Creations	3	4	4	1	12
VOC Created			6	6	12
VOC Traded			6	6	12
VOC Retired			1	1	2
VOC Balance			5	5	10
# VOC Creations			1	1	2

[a] Trading in 1996 included 363 tonnes NOx added to PERT inventory from Detroit Edison.

Source: Adapted from Clean Air Action Corporation Emissions Registry

Credit creation actions are documented in the form of a "protocol" that describes the actions implemented and the reductions achieved. The protocols are reviewed by the PERT registration team and the PERT Working Group to ensure that the reductions are real and surplus. The role of PERT in the review of the protocols is to gain information that would assist in the development of a successful emissions trading program. Review does not imply approval of the protocol; this authority remains with the provincial Ministry of the Environment.

Working Group reviews are attached to the file provided to the registry and are available to anyone purchasing the credits. Issues that have arisen in the review of credit creation protocols include:

- Are the emission reductions real? Have they actually occurred? Have they been appropriately estimated? Are the baseline emissions well established and accurate?
- Is the emission reduction claimed as a credit truly surplus to a mandatory requirement or voluntary commitment?
- Are the emission reductions additional? Would they have been implemented anyway? Were they implemented to improve environmental performance?
- Are the emission reductions verifiable? Have the best measurement technologies been used to arrive at the reduction estimates? Is the quantification replicable?
- Who owns the credit? For example, in the case of demand-side energy savings introduced by an electric utility and ultimately reflected in the cost of electricity, does the energy consumer or the utility own the credit?

One of the major activities of the PERT Working Group is to develop a draft trading rule that could serve as a template for the Ministry of the Environment, should it consider emission reduction credit trading in Ontario. The development of this rule started with a review of relevant trading rules, guidance documents, policies and regulations developed in the United States.

Participants are currently formulating a proposal for the draft rule, which is expected to include the following components:

- *Emissions reduction credits* — including identification of eligible substances, sources of emissions, units of measurement and credit eligibility criteria; computation of the emissions reduction credit; baseline determination issues; credit life; eligibility of credits for shutdown; and critical dates for generating credits.
- *Credit use and transfer* — including participant eligibility, user liability, eligible credit uses, trading zone and interjurisdictional trading, trading ratios, ozone season, environmental donation, credit transfer and credit banking.
- *Registry, reporting and monitoring* — including requirements for subscription to a registry, notices, protocols for creation and use, monitoring, documentation requirements, reporting requirements of activity, prices and confidentiality of proprietary information.
- *Audit and verification* — including authority of the Ministry to require information, defer uses pending an audit, order a third party audit, determine credit eligibility, require annual reports, perform a program audit and administer prohibitions, restrictions and penalties.

The rule is intended to be simple enough to encourage trading while maintaining environmental integrity. It is expected that the draft rule will be available for submission to the Ontario Ministry of the Environment early in 1999.

Greenhouse Gas Emission Reduction Trading (GERT)

In 1996, British Columbia, along with Environment Canada and the Greater Vancouver Regional District, funded a design study for an offsets pilot. The study was released in March 1997.[129]

The Greenhouse Gas Emission Reduction Trading (GERT) pilot was launched by a multistakeholder partnership in June 1998. The partners in the pilot include representatives of provincial, federal and local government agencies, the private sector, and labour and environmental groups. Participating governments include the Alberta departments of Energy and Environmental Protection; B.C. ministries of Energy and Mines, and Environment, Lands and Parks; Environment Canada and Natural Resources Canada; Greater Vancouver Regional District; Nova Scotia Natural Resources; Quebec Ministry of Natural Resources; and Saskatchewan Energy & Mines.

The GERT pilot is designed to:

- provide all participants with practical experience in emissions reduction trading
- assess environmental and economic benefits of emissions reduction trading
- test and evaluate the technical, administrative and legal elements of an emissions reduction trading system
- maximize involvement of the private sector by emphasizing the use of business principles to achieve environmental and economic objectives
- encourage identification of, and joint investment in, GHG emissions reduction, avoidance and/or sequestration activities
- help build the foundation for a possible future emissions reduction trading system

The GERT pilot is administered by a Pilot Manager who reports to a Steering Committee of senior representatives from participating stakeholder groups. A Technical Committee, with parallel stakeholder representation, will prepare the administrative elements (eligibility rules, measurement protocols, etc.), review projects, record and track trades, and develop an evaluation framework for the pilot as a whole.

Industry participants agree to bring forward, for review by the pilot Technical Committee, emissions reduction projects and trades that result in emissions reduction, avoidance or sequestration and to share detailed information on these projects and trades. The Technical Committee reviews projects and trades to assess whether they meet the criteria and rules established by GERT.

To be eligible for review by GERT, an emissions reduction project must have started generating emissions reductions no earlier than January 1, 1997. Projects can reduce or sequester any greenhouse gas. Projects can be located anywhere, but either the buyer or the seller must be Canadian. If the project is located outside Canada, the buyer must report the reduction only in Canada. As well, if either the buyer or seller is outside the country, use of the emissions reduction for compliance purposes will depend on future international trading agreements signed by Canada. Canadian participants must be registered in Canada's Climate Change Voluntary Challenge and Registry (VCR) Program.

The pilot will only consider projects where a trade occurs. To be eligible for registration, projects must result in emissions reductions that are real, measurable, verifiable and surplus, which have been defined by GERT as follows:

- *Real:* An emissions reduction is real if it is a reduction in actual emissions, resulting from a specific and identifiable action or undertaking, net of any leakage of emissions to a third party or jurisdiction.
- *Measurable:* An emissions reduction is measurable if the actual level of greenhouse gas emissions with the project, and the level of greenhouse gas emissions in the reference case, can be quantified.
- *Verifiable:* An emissions reduction is verifiable if the calculation methodology is acceptable, transparent and replicable and the raw data required to verify/audit the calculations are available.
- *Surplus:* An emissions reduction is surplus if it represents a reduction that is not otherwise required by law. If legal requirements affecting greenhouse gas emissions by source come

into effect during the life of the project, the reference case(s) must be adjusted to reflect the new requirements.

The Technical Committee has not yet achieved consensus on a definition of "project additionality," but is interested in exploring, on a project-by-project basis, the merits and methods for applying this criterion. Therefore, while the demonstration of project additionality is not mandatory for the registration of an emissions reduction, participants may be requested to submit information relevant to its assessment as part of the review process.[130]

Emission reductions that satisfy GERT conditions and reporting requirements will be designated as Registered Emission Reductions and will be recognized by government partners in GERT. Reporting must be done by participants to the trade on an annual basis and filed with GERT during the first quarter following the end of the calendar year. After this information has been reviewed and accepted by the Technical Committee as having met the conditions of the registered trade, the emissions reductions will be registered. The Technical Committee may require a third party review/audit at the participant's expense.

For the immediate future, buyers can use emission reductions to meet their own voluntary greenhouse gas emissions reduction targets at lower cost. For example, companies and municipalities can include GERT trades as part of their action plans registered with the Climate Change VCR Program.

Government partners may restrict the amount of emission reductions considered under the pilot. GERT will operate until December 31, 1999, unless extended by the partners.

Mandatory Performance Standards with VCT

A voluntary credit trading program with mandatory performance standards would be similar to the U.S. trading program for the lead content of leaded gasoline and the averaging, banking and trading (ABT) provisions of the heavy-duty engine emissions standards.

Trading for the Lead Content of Leaded Gasoline

Effective November 1982, the American Environmental Protection Agency (EPA) introduced trading as part of its program for phasing out lead in gasoline. The program included all refiners and importers of leaded gasoline. Trading encouraged more efficient use of lead by taking advantage of the non-linear octane response to lead.[131]

Refiners and importers were allowed to create lead rights equal to the regulatory limit on the lead content of leaded gasoline multiplied by their leaded gasoline production during the calendar quarter less the actual quantity of lead used.[132] Lead rights could be sold to other refiners and importers for use during the quarter in which they were created. The quarterly average of actual lead used by buyers could not exceed the mandated limit plus the quantity of rights purchased. Trades were reported to the EPA at the end of each quarter. Trades were not subject to an approvals process, only a potential audit.

Faced with new evidence of health damage from lead, the EPA realized that the natural reduction in lead use as leaded-fuel vehicles retired would not address the problem quickly enough. In August 1984, the EPA set a maximum lead content for leaded gasoline of 0.5 grams per gallon effective July 1, 1985, and 0.1 grams per gallon after January 1, 1986.[133]

To facilitate the reduction from 1.1 grams per gallon at the beginning of 1985 to 0.1 grams per gallon at the beginning of 1986, the EPA introduced banking into the trading system effective January 1, 1985. Refiners and importers were allowed to bank lead credits during calendar 1985 and to withdraw credits until the end of 1987. In other words, banking changed the credits from a three-month life to a maximum three-year life terminating at the end of 1987.

The lead credit trading program saved refiners over $200 million. The EPA originally estimated that approximately 9.1 billion grams of lead would be banked, and that banking alone would save refiners $226 million. The actual amount of credits banked, 10 billion grams, was close to the initial estimate, resulting in a projected average savings of 2.5 cents per gram banked.

The fact that a large number of firms entered (and exited) the gasoline "refining" business over the five years of the trading program probably contributed significantly to the cost savings.[134] The fact that so many firms entered the industry suggests that profits were relatively high. The added competition probably reduced producer profits and prices to gasoline consumers.

The lead credit trading program allowed the government to reduce the maximum lead content of leaded gasoline much more quickly than under a program without trading, where each refiner would need to have adequate time to adjust to the new standards. The lead credit trading program probably did not affect overall volume of lead use or the net environmental effects. The number of violations under the trading program was similar to the number under the previous regulatory phase-down.

Heavy-Duty Vehicle Engine Emissions Standards

Another example of a voluntary credit trading program with mandatory performance standards is the averaging, banking and trading (ABT) provisions of the emissions standards for heavy-duty truck and bus engines. The U.S. EPA regulates emissions from heavy-duty and non-road engines. The regulations cover carbon monoxide (CO), hydrocarbons (HC), non-methane hydrocarbons (NMHC), nitrogen oxides (NOx), particulate matter (PM) and smoke, but the emissions regulated differ for different engines. Some standards must be met by every engine, while others must be met by engine categories as a group. The NOx and PM standards allow the use of ABT provisions.

The regulations apply to manufacturers of spark ignition (Otto cycle) and compression ignition (diesel) engines for heavy-duty trucks and urban buses. The ABT provisions are limited to NOx and PM because the emissions standards for these pollutants have been tightened to the point where they are driving engine technology.[135] The ABT provisions were introduced to facilitate compliance with the lower standards that came into effect for the 1990 model year.

Where ABT is allowed, the regulations specify both the standard and a maximum emissions rate for the pollutant. Every engine must have an emissions rate lower than the maximum rate for each ABT pollutant.[136] The standards and maximum emissions rates for NOx and PM for different types of engines are shown here.

Engines whose emissions are lower than the specified standard generate emissions credits. Credits can be used to help engines in the same category whose emissions exceed the standard (but are below the maximum rate) achieve compliance with the standard. Averaging, banking and trading are different possible uses of credits, which are defined in the program as follows:

- *Averaging:* Credits offset emissions for engines manufactured during the same year whose emissions are above the specified average to help the company achieve compliance during that year.
- *Banking:* Credits offset emissions for engines manufactured during a future year whose emissions are above the average specified to help the company achieve compliance during that year.
- *Trading:* Credits are sold to another company and are used to offset emissions for engines manufactured during the current or a future year whose emissions are above the average specified for the year the credits are used.

Credits can only be created and used within the same engine category. There are three categories of diesel truck and bus engines: light-, medium- and heavy-duty engines. Otto cycle engines are a separate category.

Table A2.2
Standard and Maximum Emissions Rates for Heavy-Duty Engines

(grams per brakehorsepower-hour)

	Standard				Maximum			
	NOx	NOx+ NMHC	PM Trucks	PM Urban Buses	NOx	NOx+ NMHC	PM Trucks	PM Urban Buses
1988-1989[a]								
Diesel	10.7		0.6	0.6				
Otto	10.7							
1990-1992								
Diesel	6.0		0.6	0.6	10.7			
Otto	6.0				10.7			
1993								
Diesel	5.0		0.25	0.1	6.0		0.6	0.25
Otto	5.0				6.0			
1994-1995								
Diesel	5.0		0.1	0.07	6.0		0.6	0.25
Otto	5.0				6.0			
1996-1997								
Diesel	5.0		0.1	0.05[c]	6.0		0.6	0.25
Otto	5.0				6.0			
1998-2003								
Diesel	4.0		0.1	0.05[c]	5.0		0.6	0.25
Otto	4.0				5.0			
2004-								
Diesel		2.4[b]	0.1	0.05[c]		4.5	0.6	0.25
Otto	4.0				5.0			

[a] The ABT provisions did not come into effect until the 1990 model year.

[b] The standard for 2004 and subsequent years is 2.4 g/bhp-hr for NOx + NMHC or 2.0 g/bhp-hr for NOx with a cap of 0.5 g/bhp-hr for NMHC.

[c] This is combined with a 0.07 g/bhp-hr in-use standard.

Credits previously had a life of three years, but beginning in 1998 they have an unlimited life. Banked or traded credits used to be discounted by 20%, but beginning in 1998 a differential discount is applied depending on the emissions rate of the engines used to generate the credit. These changes are designed to encourage early action to meet strict new standards that come into effect in 2004.

At present, credits can only be traded among engine manufacturers. Beginning in 2004 it will also be possible to use the credits in other programs, subject to meeting the conditions of the programs for which they are purchased. For example, if new urban buses for use in an ozone non-attainment area emit less NOx than the standard, the regulatory authority might allow the NOx credits created to be used for compliance purposes by stationary sources.

Eleven manufacturers are covered by the program. Reports on ABT activity for on-highway diesel engines have been submitted on paper and are confidential. Data on use of the ABT provisions are expected to be made public late in 1998, but are currently not available. Program staff indicate that manufacturers have used averaging a little more than banking.[137] Banking tends to be used just before standards change. The first intercompany trade occurred in 1997 and involved a small quantity of PM credits. Averaging, banking and trading provisions have also been adopted or proposed for emissions from several categories of non-road engines. Specifically:

- NOx emissions by diesel engines of more than 50 hp used in non-road equipment such as farm tractors, bulldozers, cranes and forklifts[138]
- HC + NOx emissions by spark ignition outboard engines beginning with the 1998 model year and for personal watercraft engines beginning with the 1999 model year
- NOx and PM emissions by locomotives, beginning in 2000
- proposed revised HC + NOx standards for non-road spark ignition engines of less than 25 hp

The extension of ABT provisions to other engine categories suggests satisfaction on the part of the EPA and engine manufacturers with such a trading program.

Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions

Introduction

This option can best be characterized as a substance trading program. It would involve trading for the carbon content of fossil fuels, the nitrogen used in fertilizers, SF_6, HFCs and PFCs which collectively account for most of Canada's greenhouse gas emissions.[139] Both the United States and Canada have implemented substance trading programs for ozone-depleting substances. The methyl bromide part of the Canadian program is noteworthy in that it distributes the allowances to users rather than importers.

Ozone-depleting Substances — United States

Trading in production and consumption allowances for ozone-depleting substances was established in the United States in July 1989 to implement commitments under the Montreal Protocol.[140] The Montreal Protocol, which came into force on January 1, 1989, attempts to reduce the use of substances that destroy the stratospheric ozone layer.

The trading program covered five separate groups of ozone-depleting substances. These groups of substances were regulated at different times between 1989 and 1992 and were subject to different phase-out schedules.

Production allowances were allocated to five chlorofluorocarbon (CFC) producers and three halon producers.[141] Consumption allowances were allocated to five CFC producers, three halon producers, 14 CFC importers and six halon importers. A producer needed both production allowances and consumption allowances to produce a regulated substance. Importers only

needed consumption allowances to import ozone-depleting substances.

Each participant was allocated allowances for production (consumption) of each substance based on the participant's baseline year market share of the production (consumption) of that substance.[142] The formula for allocating allowances did not change over the life of the program, but the quantity of allowances received by participants each year declined as the production (consumption) cap was phased out. There were no new producers or consumers of ozone-depleting substances over the life of the program. Allowances were substance-specific, but could be traded for other substances within the same group.[143]

The trading program was complemented by a tax on ozone-depleting substances and regulations governing allowable uses for the different substances. As a result of this combination of measures, U.S. consumption of CFCs dropped from about 300,000 tonnes in 1989 to about 40,000 tonnes in 1995. Consumption was well below allowable levels in 1990, 1991, 1992, 1993 and 1995.[144] Nevertheless, about 30% of allowable production was exchanged in inter-company trades.[145]

In summary, the trading programs for ozone-depleting substances used a very simple grandfathering allocation rule — each participant received its share of the baseline (1986 or 1989 depending upon the substance) production (consumption) of each substance. The shares of the allowable production (consumption) did not change over the life of the program.

Ozone-depleting Substances — Canada

Canada has used a system of "consumption allowances" to meet its Montreal Protocol commitments. Under this system, Canada's maximum consumption of each group of ozone-depleting substances as established by the Protocol is divided among Canadian companies. Each company receives allowances equal to its share of Canada's consumption of that group of substances during the specified base year. Transfer of consumption allowances between companies has been permitted since 1993.

CFCs and methyl chloroform were the first substances covered by the transferable consumption allowance system. Although there were no restrictions on the transfer of allowances, companies involved in a transfer had to request approval from Environment Canada. The purpose of this approval was to verify that the quantity transferred by a company was indeed still unused and therefore available for the transfer. It also kept Environment Canada informed of the maximum consumption each company was allowed.

Only a few transfers of CFC and methyl chloroform allowances took place between 1993 and 1996, when production and imports of these substances ceased. This was due to the small number of companies involved, about 12 for each category of substances, and the intense competition among the companies. The possibility that the buyer could gain market share from the seller was more important than the revenue from the sale of unused allowances to a competitor.

Methyl bromide allowances were introduced in 1995.[146] In contrast to the other ODS allowances, methyl bromide allowances were distributed to *users* rather than importers. This was done to address the concern that, given the small number of importers (five), they could control the market. Some importers apply the substance themselves and sell it to other applicators, so a distribution to importers might place firms that are only applicators at a disadvantage relative to firms that are both applicators and importers.[147] From a logistical point of view, distribution to users was a viable alternative as the total number of users was relatively small (133).

The hydrochlorofluorocarbon (HCFC) consumption allowance system came into effect on January 1, 1996. In this case, the importers get the allowances. Since Canada's allowable HCFC consumption under the Protocol is based on an

estimate of HCFC needs to replace CFCs, and the demand for HCFCs was less than the allowable consumption, Environment Canada distributed consumption allowances equal to about 80% of the allowable consumption. The other 20% will be distributed based on market demand.

HCFC consumption allowances are divided into categories: refrigeration uses and other uses. Transfers can only take place within a category. No transfers have occurred yet. The reasons are similar to those noted above for CFCs: competition among the small number of firms (about 12) in each category. Concern about possible loss of market share due to a transfer overwhelms the potential revenue.

In summary, consumption allowances for ozone-depleting substances are grandfathered — allocated on the basis of each participant's base year share of consumption. With the exception of methyl bromide, allowances are issued to importers and producers. Methyl bromide is interesting because the allowances are issued to the users rather than the importers to allay concerns about market power.

Downstream Greenhouse Gas Emissions Allowance Trading with VCT

Several downstream cap and allowance emissions trading programs have been implemented in the United States to address a range of environmental issues. This section will briefly discuss two of the best known of these trading programs.[148]

Title IV Acid Rain Program

The legislation to create this sulphur dioxide cap and allowance emission trading program was passed in 1990 under Title IV of the U.S. *Clean Air Act* of that year. The program is designed to achieve a 7.7 million metric tonne reduction in SO_2 emissions from electric utilities between 1995 and 2010.

In Phase I, which runs from 1995 through 1999, 110 utilities are required to hold emission allowances for 263 high emitting coal-fired boilers. Depending on how these units are operated, utilities may choose or be required to include other units under their control. The actual number of units participating in the program has exceeded 400 each year so far. In Phase II, beginning in 2000, an additional 1,800 boilers are required to enter the program.

The number of allowances distributed each year drops as the emissions cap becomes more stringent. Each allowance allows an emitter to emit a short ton of SO_2. Distribution of allowances to participants in the program is *gratis* and is based mainly on historic fuel purchase levels, but adjusted by numerous special provisions. Non-utility sources can opt in to the program and receive an allocation of allowances. Only two industrial sources and one small utility source have opted into the program so far.

In 1995, 8.74 million tons of allowances were allocated and this fell to 8.30 million tons in 1996. Trading volumes were 1.92 million tons in 1995 and 4.41 million tons in 1996. Most trades were among units within the same utility; internal trading was about double the level of intercompany trading. During 1998, allowance prices have increased from about $100 to $200 per ton.

Monitoring of emissions under the program is extremely strict, using tamper-proof Continuous Emission Monitors (CEMs). Operators with emissions that exceed their allowances must pay automatic administrative penalties (currently almost 20 times the current trading price for allowances) and must also purchase allowances to make up for the exceedance. To date, the government costs of administering the program and transaction costs have been relatively low.

Regional Clean Air Incentives Market (RECLAIM)

California's South Coast Air Quality Management District (SCAQMD) established the Regional Clean Air Incentives Market (RECLAIM) as an alternative to command and control regulations

for large point sources of NOx and SOx. The cap and allowance emission trading program applies to all facilities (about 330) that emitted 3.6 tonnes or more of nitrogen oxides and sulphur oxides in 1990 or later. Smaller facilities can elect to join the program; only four have done so to date.

Emission allowances are issued *gratis* to participants on the basis of historic production levels and emission factors applicable to the type of facility. If a facility does not trade allowances, allowable emissions decline by about 7%-8% per year. New and significantly modified facilities must obtain allowances to offset their emissions, and are still subject to regulated technology standards.

Sources can also make use of credits created by reductions at other sources not regulated under the program (as in the options outlined in Chapter VI). In 1994, emissions reductions at other sources produced credits equivalent to 4.5% of NOx allowances and 9.7% of SOx allowances. While this sounds significant, the reality is that actual emissions had been 16% to 37% below the allocated allowances over the first three years of the program. As a result, credits from outside sources do not represent a significant part of the program.[149] The percentage may rise as the RECLAIM caps become more stringent. Credits cannot be banked, so there is no incentive to use credits from external sources unless they are needed during the current year.

A complaint that has been made about the RECLAIM program is that, at the outset, allowable emissions were higher than actual baseline year emissions. This was a result of giving firms flexibility in determining historic production and emission levels that were the basis for allowance allocation, and all firms chose high production and emission years. However, actual emissions do not appear to have increased during the initial years. There is disagreement as to whether RECLAIM's emission results represent an improvement over the original air quality plan, but the program is projected to save about $58 million compared to the costs of prescriptive standards.

Endnotes

1 Multistakeholder Expert Group members participated in three closed workshops (May 1998, September 1998 and January 1999) and offered comments on draft documents. A full list of the members is provided on page 4 of this report.

2 In contrast most regulations impose a requirement on affected sources to implement and pay for specified emission reduction actions.

3 If allowances are sold at auction, sources must pay for the allowances they need to cover their actual emissions. Sources have an incentive to implement measures to reduce emissions whose cost per unit is less than the price of an allowance. How the burden is shared depends upon the market price of allowances and the manner in which the auction revenue is used.

4 These pilots are the Greenhouse Gas Emission Reduction Trading Pilot (GERT) and the Pilot Emission Reduction Trading Program (PERT). See Appendix 2.

5 Statement from the April 24, 1998 joint meeting of federal, provincial and territorial ministers of energy and environment.

6 One of the guiding principles for a "Credit for Early Action" system endorsed by federal, provincial and territorial energy and environment ministers at their October 1998 meeting.

7 A single standard of Z kg of CO_2 per kWh of electricity generated would enable hydroelectric generating units to earn credits without taking any action. To reduce emissions the standard would need to be lower than the emissions from a coal-fired generating station. In effect, then, coal-fired units would need to purchase credits from hydroelectric units. This can be interpreted as penalizing coal-fired units and rewarding hydroelectric units. But it created an incentive to increase hydroelectric generation and reduce coal-fired generation and so reduce emissions. Establishing separate standards for different types of generation, say 0 for hydroelectric generation and Y kg of CO_2 per kWh of coal-fired electricity, may be seen to be more equitable, but it significantly reduces the incentive to switch from coal-fired to hydroelectric generation.

8 There was a great deal of discussion within the NRTEE Multistakeholder Expert Group about the relative incentive provided by: (a) a price signal generated by a carbon tax or domestic emissions trading program imposed upstream of the emissions source, or (b) the imposition of a regulatory requirement to limit emissions through a domestic emissions trading program. Some members of the group felt that the incentive to take action would be no different, while others strongly believed that direct regulation through a trading program provides a stronger incentive to act.

9 The Kyoto Protocol sets out emission limitation commitments for 38 countries, including Canada and the European Union. Canada's commitment is to limit average emissions for the period 2008-2012 to 94% of 1990 emissions.

10 A trading program could require that larger sources participate on an entity basis while smaller sources are allowed to create credits on a project basis.

11 The Pilot Emission Reduction Trading (PERT), Greenhouse Gas Emission Reduction Trading (GERT) and NESCAUM pilot projects rely on review by experts from participating organizations, supplemented by external technical experts. PERT and GERT are described in Appendix 2. NESCAUM is the Northeast States for Coordinated Air Use Management, an organization of the air quality directors of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont.

12 If the motivation for participating in the voluntary trading program is a belief in the need for action or a desire to improve the corporate image, the objective can probably best be reached by creating credits and not selling or using them. Many proposals for "credit for early action" encourage credit creation and banking for later use to help meet future regulatory obligations. Thus, "credit for early action" may discourage use of credits during a voluntary trading program.

13 Potential uses of credits allowed by a credit for early action program include:
- credits within a future allowance or credit trading scheme
- credits against future regulatory (standards) or fiscal (tax) obligations

- credits that provide access to specific government programs or initiatives
- sale to government.

14 A commitment that provides a firm, near-term value, such as an offer to purchase all available credits beginning immediately at a price of $Z per CO_2 equivalent tonne, provides a much stronger incentive than a commitment that provides a conditional, long-term value, such as allowing credits that meet the criteria established by a possible future program to be used to meet commitments after 2007.

15 Technically those mechanisms cannot begin operation until the Kyoto Protocol comes into force. The assumption for this option is that Canada faces the prospect of, but not an actual, national commitment to limit its greenhouse gas emissions. The international flexibility mechanisms could begin operation on an interim basis before the Kyoto Protocol comes into force. Or the Kyoto Protocol could come into force before Canada ratifies it.

16 The federal, provincial and territorial ministers of energy and environment have committed to implement a program of credit for early action in the spring of 1999 and have established an Issue Table to examine how this might be done.

17 In this policy setting, current emissions of greenhouse gases are not limited by an international agreement, but the prospect of a national commitment to limit emissions exists. Governments could begin to implement regulations to limit greenhouse gas emissions to minimize disruption if the future commitment comes into force. Participants in a voluntary trading program could argue for exemption from such regulations, at least until the commitment comes into force.

18 A distinction is sometimes made between actions implemented by a company to reduce emissions from its own operations and actions financed by a company to reduce emissions (increase sequestration) by other sources. The latter are called offsets. Here it is assumed that the emission reduction (or sequestration) action, regardless of where it is implemented or how it is financed, must meet the criteria adopted.

19 Climate Change Secretariat, *Work on Methodological Issues*, FCCC/SBSTA/1997/INF.3, Subsidiary Body for Scientific and Technological Advice, Seventh Session, Bonn, 20-29 October 1997. The report deals with methodological issues relating to Activities Implemented Jointly (AIJ), a form of voluntary credit trading for greenhouse gas emissions.

20 Issues related to the criteria for credit creation are discussed at length in the NRTEE Issue Paper, *Possible Criteria for the Creation of Emissions Reduction Credits Under a Domestic Emissions Reduction Credit Trading Program* (January 1999). PERT requires emissions reductions to be real, quantifiable and surplus. PERT defines the baseline as the emissions that would otherwise occur, so reductions from the baseline are automatically "additional." GERT requires emissions reductions to be real, measurable, verifiable and surplus. GERT is interested in exploring, on a project-by-project basis, the merits and methods for applying an additionality criterion. The Climate Change Secretariat document, *Work on Methodological Issues*, FCCC/SBSTA/1997/INF.3, Subsidiary Body for Scientific and Technological Advice, Seventh Session, Bonn, 20-29 October 1997, deals with methodological issues relating to Activities Implemented Jointly (AIJ), a form of voluntary credit trading for greenhouse gas emissions. It defines the criteria as follows:
- The environmental benefits of an emission reduction or sequestration action would be recognized as *real* if the actual GHG emissions or sequestration can be shown to differ from a credible and probable baseline scenario, taking leakage into account.
- The environmental benefits of an emission reduction or sequestration action are considered to be *measurable* if the actual level of GHG emissions of the project case and the level of GHG emissions in the baseline scenario can be established with a reasonable degree of certainty.
- The environmental benefits of an emission reduction or sequestration action can be recognized as *additional* if it can be demonstrated that the resulting environmental benefits related to GHG would not have otherwise occurred. The reduction or sequestration must also be surplus to any regulatory requirements.

- The environmental benefits of an emission sequestration action can be recognized as *long term* if the emissions are sequestered for an appropriate period of time, which may extend beyond the life of the project.

21 Adjusting the baseline *ex post* over time to reflect actual developments, such as changes in energy prices and technology and rate of adoption of emissions mitigation or sequestration technologies, would probably yield a more credible baseline and hence a better indication of the extent to which the emission reductions are additional. But *ex post* adjustments to the baseline increase uncertainty for investors and hence may reduce investment in emission mitigation measures.

22 PERT reviews credit creation actions but does not approve the credits. It has adopted a principle of buyer liability. The Ontario Ministry of the Environment will determine whether the credits meet the applicable criteria when the credit creator or buyer tries to use them for compliance purposes. GERT has decided that the Technical Committee will determine the number of credits created by actions undertaken by participants.

23 See the NRTEE Issue Paper, *Analysis of Emissions Trading Program Design Features* (January 1999) for a discussion of liability for the validity of credits or allowances. Liability establishes which party is responsible for ensuring that the credits are valid when they are traded. If the seller is responsible, the buyer can accept the credits knowing they will be valid. If the regulator does not accept the emission reduction credits claimed by the seller, it must provide additional credits to the buyer. If the buyer is responsible, it must decide whether the regulator is likely to accept the credits for compliance purposes. If the buyer is responsible and the credits are not accepted by the regulator, it may need to purchase replacement credits quickly to achieve compliance.

24 For example, countries with commitments to limit their greenhouse gas emissions during the 2008-2012 period under the Kyoto Protocol cannot count reductions achieved domestically before that time toward their commitment. Such a country could still recognize early reductions domestically, but it would then need to achieve larger reductions during the 2008-2012 period. To illustrate, Canada's emissions during the period would need to be 6% below 1990 levels, an average of 563 Mt per year.

Assume first that the credit for early action takes the form of government purchases of credits or tax incentives. Then the programs implemented during the period will need to limit emissions, on average, to 563 Mt per year. And to the extent that the early actions persist throughout the 2008-2012 period, those sources will have achieved some or all of the reductions they need to make to achieve compliance.

Assume now that the credit for early action takes the form of credits that can be used for compliance with regulatory obligations during the 2008-2012 period and that X Mt of such credits have been awarded. Assume also that the same programs were implemented to limit emissions, on average, to 563 Mt per year. The credits of X Mt for early actions would be used for compliance by the credit creators or by others. The result is that actual emissions during the 2008-2012 period average 563 + X/5 Mt per year. To achieve compliance with its international commitment, Canada would need to implement policies to reduce emissions to an average of 563-X/5 Mt per year, so that actual emissions during the period will average 563 Mt when the credits for early action are used for compliance with the domestic policies.

25 See Appendix 2. These programs are also discussed in the NRTEE Issue Paper, *Analysis of Options for* Gratis *Distribution of Allowances* (January 1999).

26 Participants should have an incentive to implement all cost-effective measures to reduce GHG emissions. For energy users, this means all energy-efficiency and conservation measures and all fuel switching options that reduce GHG emissions. Expressing the performance standard in terms of energy-related GHG emissions per unit of output covers all of those options. In contrast, expressing the performance standard in terms of energy-related GHG emissions per unit of energy input provides an incentive to switch to less carbon-intensive fuels, but not to implement energy-efficiency or conservation measures. Thus, an output standard is better than an input standard for energy consumers.

27 The standards for large energy users would apply to all greenhouse gas emissions by each participating entity, not just to specific processes or activities.

28 The number of credits is calculated as follows: 1,548,000 widgets multiplied by the standard of 0.1 kg of CO_2 equivalent per widget divided by 1,000 kg per tonne of CO_2 for a total of 154.8 CO_2 equivalent tonnes.

29 The number 0.5 kg of CO_2 per kWh is purely hypothetical. It is used simply to facilitate the discussions and should not be interpreted as a proposed standard.

30 Note that the standard applies to the actual sales of 889 MWh, not the projected sales of 867 MWh.

31 A source would not need to document specific actions implemented to reduce its emissions. Rather, credits are created by documenting that actual emissions are lower than allowed by the mandatory performance standard. The sources and output covered are also specified by the performance standards.

32 The standard is equivalent to a *gratis* allocation of allowances to each participant equal to the performance standard multiplied by the participant's output. The distribution of allowable emissions among participants changes each year as output changes.

33 The definition of a large energy user will depend upon whether the entities subject to the mandatory performance standards are firms or individual plants. Further analysis is needed to assess the trade-offs in terms of the number of participants, administrative burden on participants and governments, and the share of total emissions covered by implementing the program for individual plants or firms.

34 The possibility that participants would restructure their operations to achieve compliance, possibly giving rise to leakage, needs further study. An entity, for example, might be able to restructure its operations so that some or all of the new operations are not subject to mandatory performance standards. A participant might be able to achieve compliance with a standard based on emissions per dollar of sales (per unit of energy input) by merging with another operation with low emissions per dollar of sales (per unit of energy input). Under either of these examples total emissions could increase without violating the performance standards.

35 The test procedure might measure emissions during urban and highway driving cycles. And the use profile might assume an average of 12,000 km per year, of which 60% is urban driving and 40% is highway driving.

36 The credits would be distributed over time, based on the scrappage profile and usage pattern for vehicles. Thus, of the 3,000 CO_2 equivalent tonnes of credits over the life of the vehicle, 350 tonnes might be assigned to the current year because new vehicles are heavily used and the scrappage rate is low, while 20 tonnes might be assigned to the 15th year of the expected vehicle life because most of the vehicles will have been scrapped and the remaining old vehicles will tend to be used less than the fleet average. A standard profile would be used to allocate the stream of credits for each type of appliance, equipment, vehicle and building over time.

37 An alternative to converting the appliance, equipment, vehicle and building standards into a stream of credits over the life of the product is to establish a series of separate trading programs, each limited to the performance standard of a product category with a comparable lifetime and usage pattern. For example, the standard would be defined for a basic residential refrigerator. Over-compliance and under-compliance would be measured in fractions of the standard. A manufacturer that sold 10,000 refrigerators in Canada that outperformed the standard by 1% would receive 100 refrigerator credits. The refrigerator credits could only be used for appliances in the residential refrigerator category. The drawback of this approach is that it would create a number of separate trading programs, each with only a small number (fewer than 15) participants. The experience of the U.S. averaging, banking and trading (ABT) program for heavy-duty vehicle engine emissions standards and the Canadian ozone-depleting substances program is that there is very little inter-firm trading in such cases.

38 Small industrial sources are those whose annual emissions (or sales or energy use) are less than the threshold defined for large energy users subject to mandatory performance standards.

39 Given the structure of the domestic trading system, most Canadian participants are likely to hold credits. Surplus credits could be exchanged for "assigned amount" and be sold to a buyer in another country under the provisions of Article 17. It is possible that some emission reduction actions could be structured as joint implementation projects and so create emission reduction units that could be exported under the provisions of Article 6. The clean development mechanism (CDM) applies to projects implemented in developing countries, so Canadian participants can only purchase (not create) CDM credits.

40 Many of these provisions are discussed in the NRTEE Issue Paper, *Analysis of Emissions Trading Program Design Features* (January 1999).

41 Setting the standards conservatively, so that they are likely to be met under virtually all weather and economic conditions, could be costly. The Multistakeholder Expert Group discussed two ways to deal with this issue. One is to adjust the standards as information on actual emissions and the likelihood of achieving the national commitment becomes available. Given the lags involved in collecting information on actual emissions and the time needed to change standards, a five-year commitment period would probably allow time for only revision to the standards. The second approach is to establish maximum output levels, which together with the performance standards, enable the national commitment to be met. Allowable emissions are determined by the performance standard and actual output up to the maximum output. For output beyond the maximum, the performance standard would drop to zero, meaning that all emissions associated with the extra output would need to be offset with credits. A third mechanism for meeting the national commitment if actual emissions appear to be too high is to levy a fee on emissions and use the revenue to purchase assigned amount, or equivalent instruments, internationally to achieve compliance.

42 The need to adjust for inflation raises difficult issues in terms of the appropriate inflation index for each firm. It is impractical to calculate a suitable inflation index for each firm, so a widely available index such as the gross domestic product deflator or Consumer Price Index would probably be adopted for this purpose.

43 The performance standard for the firm could be constant for some period or could become more stringent over time. An example of a constant standard would be a 25% reduction from the 1995 emissions per dollar of output (adjusted for inflation) for the period 2008-2012. An example of a standard that becomes more stringent would be a 1% per year reduction from the 1995 emissions per dollar of output (adjusted for inflation). Assuming the actual emissions reductions involved are the same, a firm might prefer the declining standard if banking is allowed.

44 Emissions of new vehicles are tested for a highway and an urban driving cycle. Using data on average vehicle lifetime (say 150,000 km) and the mix of urban (60%) and highway (40%) driving, it is possible to estimate the lifetime emissions. Many appliances and a lot of energy-using equipment use electricity as their main or only energy source. The test procedure for such products would be defined in terms of electricity use. This would be converted into greenhouse gas emissions using an average emissions coefficient for electricity.

45 Meeting a revised standard early will also generate credits since the revised standard will presumably be more stringent than the existing standard.

46 Procedures for calculating the energy use of a building are available. Such a procedure would form the basis of the emissions performance calculation. Since weather conditions have a substantial impact on building energy use, the emissions standards would need to vary by region.

47 A builder could also seek a variance that did not affect the emissions performance. Again, the architect and/or mechanical engineer would need to demonstrate that the emissions performance was not affected.

48 Statistics Canada reports 32,718 manufacturing establishments in Canada in 1995. The number has fluctuated between 30,000 and 40,000 over the past 25 years, usually between 32,000 and 35,000. In 1995 the number of establishments with annual sales in excess of $5 million was 8,400, and the number with

sales in excess of $50 million was 1,283. Estimates in Chapter VI of this NRTEE study put the number of industrial firms in energy-intensive industries at approximately 400.

49 The lower end of the range includes the large energy-intensive industries identified in the description in Chapter VI. The upper end of the range is the number of establishments with sales in excess of $25 million.

50 Since most energy-related CO_2 emissions would be covered by the performance standards, the number of sources able to reduce emissions without double counting is relatively small. Perhaps the largest category is improvements to the building shell, but not to the heating and cooling equipment, lighting or appliances of existing buildings. Sources that implemented such measures could document the reductions and sell the stream of credits to participants subject to the mandatory performance standards. In addition, credits could be earned for capture of emissions from small landfills, open pit mines, and for carbon sequestration actions allowed by the international emissions limitation agreement.

51 Switching from coal-fired generation to hydroelectric generation over time should be encouraged as one way to help meet the national commitment. Assume that separate standards are established for coal and hydroelectric generation and that the standard for hydroelectric generation is zero. As long as the emissions standard for coal-fired units can be met there is no incentive to switch to hydroelectricity. And if a company can better the coal-fired standard, it has an incentive to increase its coal-fired output because it earns credits for each additional unit of coal-fired output. Similarly, establishing different standards for different sizes of refrigerators or automobiles provides no incentive to smaller units that use less total energy and hence have lower total emissions. That is why the CAFE standards apply to all vehicles sold by a company, regardless of size.

52 A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, Table S5, p. xv. When combined with air and rail, total greenhouse gas emissions for the large stationary sources amounted to 235,980 CO_2 equivalent kilotonnes (kt). This is just under 50% of the total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

53 Ibid. Commercial, residential, agriculture, public administration, steam generation, other and mobile source emissions other than air and rail amounted to 237,656 CO_2 equivalent kt, of which 65% is due to mobile sources. The total is just over 50% of the total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

54 This includes approximately 75% to 80% of the emissions by air, rail and large stationary sources; 10% of the commercial, residential, agriculture, public administration, steam generation, other and mobile source emissions; 80% to 100% of cement and lime production, chemical production, other non-energy uses, waste incineration, fertilizer use, landfill and anaesthetic use emissions; and a share of upstream oil and gas, coal mining and natural gas distribution emissions.

55 To enable sources to create and use credits in conjunction with the mandatory performance standards, the regulations promulgated by the federal, provincial and municipal governments to implement the standards should reference the credit trading organization and its rules.

56 It is not necessary to establish criteria for credit creation for sources subject to mandatory performance standards. If actual performance results in lower emissions than the standard, credits equal to the difference can be claimed. The mandatory performance standards become the baseline for credit creation and use. Thus, concerns about additionality must be addressed when establishing the performance standards.

57 It may also be necessary to require sources to meter some types of non-purchased energy. However, because use of wood waste should be encouraged as a substitute for fossil fuel use, it would not be necessary to meter the quantity of wood waste used. This would encourage such substitution.

58 See also the NRTEE Issue Paper, *Policies That Could Complement a Domestic Emissions Trading System for Greenhouse Gases* (January 1999).

59 WTO rules specify that imports cannot be required to meet more stringent standards than comparable domestic products. Since the objective is to reduce emissions, there is no reason to allow less stringent emissions performance standards for imports. Hence, both imports and domestic products should be subject to the same emissions performance standard.

60 See the NRTEE Issue Paper, *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks* (January 1999).

61 Fossil fuels contain elemental carbon and various carbon compounds. The carbon content of coal, crude oil and natural gas at the mine mouth or wellhead varies from source to source and over time, but can be accurately determined through relatively inexpensive chemical analyses. Pipeline-quality natural gas and different petroleum products must meet product specifications that determine the carbon content to very close tolerances. When a fossil fuel is burned to provide energy, the carbon combines with oxygen from the air to form CO_2, which is a greenhouse gas. Thus it is possible to accurately determine the energy-related CO_2 emissions from the carbon content of fossil fuels. And controlling the carbon content of the fossil fuels used is an effective way to limit the resulting CO_2 emissions.

62 Descriptions of these emission sources and how they could be incorporated into the trading program are provided in the NRTEE Issue Paper, *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program* (January 1999).

63 Given the structure of the domestic trading program, most Canadian participants are likely to hold allowances. Surplus allowances could be exchanged for "assigned amount" and be sold to a buyer in another country under the provisions of Article 17. It is possible that some emission reduction actions could be structured as joint implementation projects and so create emission reduction units that could be exported under the provisions of Article 6. The clean development mechanism (CDM) applies to projects implemented in developing countries, so Canadian participants can only purchase (not create) CDM credits.

64 The Canadian Association of Petroleum Producers (CAPP) has 184 members, which are large and medium-sized companies. The Small Explorers and Producers Association of Canada (SEPAC) has 430 members, many of which are explorers rather than producers. The total is 614 companies, not all of which are producers. Estimates by industry observers suggest that 300 to 400 oil and gas producers, including all CAPP members, are responsible for about 95% of total production.

65 The 23 refineries are owned by 13 companies and the 789 gas plants are owned by 171 companies. But duplication of ownership reduces the list to fewer than 180 companies.

66 The carbon content of imported natural gas and petroleum products could be calculated from the product specifications. Imported crude oil might need to be tested to determine the carbon content. This could be done by the importing refinery.

67 A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, p. A-3.

68 Ibid., p. 34.

69 The composition of coal is analyzed by mining companies as it is produced. Purchasers also have the coal analyzed, usually at the point of loading. Thus data on the carbon content of the coal produced, exported and imported can be calculated from these analyses and the related quantities.

70 *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks* (January 1999).

71 These options are discussed in the NRTEE issue papers. Regardless of how the allowances are distributed, fossil fuel producers and importers would need to hold allowances equal to the carbon content of their fossil fuel sales. If the fossil fuel importers have to buy the allowances because they are auctioned by the government or distributed *gratis* to other groups, the prices of the fossil fuel products they sell will rise due to the cost of purchasing the allowances. If the allowances are distributed *gratis* to the fossil fuel producers and importers, the prices of their products will rise by the same amount even though they have not incurred any expense to acquire the allowances.

The reason is that the total quantity of carbon content in fossil fuels is the same in both cases and that fossil fuel producers can do little to reduce the carbon content of their products. Therefore, the prices of fossil fuel products must rise to the point where fuel switching and energy efficiency adjust the demand for fossil fuels so that the carbon content of the fuels used equals the available carbon content. Since the demand and supply of carbon content must be balanced through changes in the prices of fossil fuels, the price increases are approximately the same whether the fossil fuel producers have to buy the allowances or receive them *gratis*. Of course, if they receive them *gratis* they experience a windfall profit as a result of the higher prices for their products with no increased costs.

Energy users will bear the initial burden of the price increase. Thus an argument can be made that a more equitable arrangement would be to distribute the allowances *gratis* to energy users and to require the fossil fuel producers and importers to buy the allowances from the energy users. In that way the payments the energy users receive for the allowances offset the higher energy costs. There are several difficulties with this approach. First, it is administratively complex; 350 to 700 fossil fuel producers and importers would need to buy allowances from tens of thousands of energy users. Second, finding an equitable formula for distributing the allowances to the thousands of energy users that still leaves them with an incentive to use energy more efficiently and to switch to less carbon-intensive energy sources would be difficult. Third, if the energy users increase the prices of their products to reflect the higher energy prices, they can capture the windfall profits.

Ultimately, the economic burden of limiting GHG emissions is borne by individuals. Thus it can be argued that the allowances should be distributed *gratis* to individuals to offset the economic burden they bear. Then the 350 to 700 fossil fuel producers and importers would need to purchase the allowances they need from 30 million individuals. An auction with redistribution of some of the revenue to energy users or individuals through the tax program is much easier from an administrative perspective, and it allows the amount distributed to various categories of energy users and individuals to be adjusted to more accurately reflect the burdens they bear.

72 At $10 per tonne of carbon ($2.72 per tonne of CO_2) an auction would raise about $1.5 billion per year under this design. The Multistakeholder Expert Group discussed possible uses of the auction revenue, but did not achieve consensus on those uses. Possible uses include reducing existing taxes, transitional or permanent tax credits to energy-intensive export-oriented industries, and investments in public infrastructure to reduce emissions. An NRTEE Issue Paper, *Analysis of Options for Distributing Allowances by Auction* (January 1999), discusses options for use of auction revenue.

73 These are discussed in an NRTEE Issue Paper, *The Legislative Authority to Implement a Domestic Emissions Trading System* (January 1999).

74 Any emissions trading program, indeed any regulation, that limits energy-related CO_2 emissions will lead to price increases downstream of the point of application. Different emissions trading program designs that cover the same energy uses and have the same overall limit on emissions should lead to the same price increases, assuming perfectly competitive markets. However, different emissions trading program designs generally involve different levels of coverage, so the energy price impacts may differ. The price impacts of a trading program implemented upstream of regulated utilities may differ from those for trading programs that involve regulated utilities due to the manner in which their prices are regulated.

75 The price increases are not the only impacts. Some of the costs of purchasing allowances at auction might be shifted to shareholders through lower profits and share prices, to employees through lower wages, or to suppliers through lower prices for their products.

76 The Multistakeholder Expert Group discussed options that might allow some of these sources to participate in the trading program. For example, aluminum smelters might be required to hold allowances for PFC emissions based on a proxy for emissions per tonne of production and smaller landfills might be required to hold allowances for the quantity of waste

received. Sources able to demonstrate that their actual emissions were below the proxy values would be required to hold allowances equal to their actual emissions. In the case of enteric fermentation and animal manure emission factors could be established for products such as a litre of milk, a veal calf, a slaughter steer, etc. Purchasers of those products, such as dairies and meat packers, would be required to hold allowances for their purchases. Farmers could earn credits by implementing practices to reduce emissions from those sources. They could sell the credits or transfer them to the purchasers of their products.

77 The methane (CH_4) and nitrous oxide (N_2O) emissions associated with energy use are covered by the Kyoto Protocol commitment. Those emissions could be covered by adjusting the carbon content of different fuels to incorporate the associated CH_4 and N_2O emissions where they are not addressed separately in the design of the trading program.

78 The total includes all sources except livestock and manure, soils, prescribed burning, wastewater/compost, and wood fuels (wood fuels are not covered by the Kyoto Protocol commitment). These exclusions reduce the coverage from the Canadian total of 619 million CO_2 equivalent tonnes in 1995 to 593.5 million CO_2 equivalent tonnes. This figure must be reduced by some portion of the upstream oil and gas emissions, coal mining emissions and PFCs from aluminum smelting not covered by the trading program, suggesting total emissions covered by the trading program in the range of 560 to 585 million CO_2 equivalent tonnes. See A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, Table A-4, p. A-6.

79 Among the issues considered to require further study are options such as beginning with a *gratis* distribution and phasing in the auction. This transition could begin before the national commitment comes into force. Assuming the Kyoto Protocol comes into force, for example, this could mean launching the trading program before 2008 (say 2005) with *gratis* distribution of allowances with a transition to an auction of all of the allowances during the 2008-2012 period.

80 Firms may prefer to purchase from brokers to keep their actions anonymous if auction results are public. As well, participants in the auction may need to need to demonstrate that they meet certain standards (e.g., creditworthiness) so firms may find it more convenient to buy from a broker. The auction may also use minimum lot sizes (e.g, 1,000 tonnes CO_2 equivalent) that are too large for a given firm. A relatively small number of financial institutions participate in the Treasury Bill auctions. Mutual funds, stockbrokers and other organizations that want Treasury Bills buy them from these institutions. In addition to brokers, a firm could buy allowances from fossil fuel exporters or petrochemical producers, or buy credits from operators of small landfills or sequestration projects, and on the international market.

81 See the NRTEE Issue Paper, *Policies That Could Complement a Domestic Emissions Trading System for Greenhouse Gases* (January 1999).

82 See the NRTEE Issue Paper, *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks* (January 1999), p. 7.

83 The next program discussed in this paper builds on this program and incorporates transportation-related emissions by requiring petroleum refiners to hold allowances for the carbon content (future emissions) of the transportation fuels they sell.

84 The impacts on economic efficiency would be minimized if the emitters covered by the program are the emitters that have the lowest cost opportunities to reduce emissions. It is not clear, however, that this is the case. For example, many cost-effective emission reduction opportunities in the residential and commercial sectors would not be addressed under this option.

85 Airlines and railways are included because they are small in number and an important contributor to overall emissions. Other sources of transportation-related emissions (e.g., cars, freight trucks) are not included because the number of entities (companies or individuals) owning these vehicles is too large to be incorporated into this program. It should be noted that airlines will only be responsible for emissions generated by flights within Canada as there is as yet no agreement

internationally on the assignment of responsibility for fuels associated with international transportation (bunker fuels).

86 The NRTEE Issue Paper, *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program* (January 1999) concludes that it would be difficult to establish emissions rights trading or credit trading programs for fugitive methane emissions from oil production and natural gas production, transmission and distribution. It is too difficult to make accurate estimates of these emissions.

87 It is estimated in the NRTEE Issue Paper, *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program* (January 1999) that 65% of methane emissions from landfills come from only 120 of Canada's approximately 10,000 landfills.

88 The extended description of Voluntary Credit Trading in Chapter III examines issues related to the creation of such credits and the administration of a credit trading program.

89 This concept is discussed in more detail in *US Carbon Emissions Trading: Some Options That Include Downstream Sources* (Center for Clean Air Policy, 1998).

90 Of the 86 leading submissions made by industry to the Voluntary Challenge and Registry (VCR) in 1997 (as identified in a review by the Pembina Institute), 72 had emissions of more than 100 kt in 1996. This figure is high, however, because most of these sources have included emissions associated with the production and distribution of the electricity they use in their greenhouse gas emission inventories. In this option, those emissions are the responsibility of electric utilities. As a result, the number of these VCR participants meeting the 100 kt limit is likely to be somewhat smaller.

91 The issue of legislative authority for an emissions trading program is discussed in more detail in the NRTEE Issue Paper, *The Legislative Authority to Implement a Domestic Emissions Trading System* (January 1999), but it is clear that more research is required in this area.

92 *Analysis of Emissions Trading Program Design Features* (January 1999).

93 If an entity receives allowances *gratis* and then shuts down its GHG-emitting operations and reopens them in another country, it may be appropriate to have a mechanism that ensures those allowances revert back to government.

94 The conversion factors related to energy-related greenhouse gas emissions are reasonably accurate and virtually all of Canada's greenhouse gas emissions inventory is calculated through the use of such factors.

95 There is some debate as to whether or not continuous emission monitors or fuel meters provide the more accurate estimates of emissions.

96 Issues regarding the treatment of fossil fuel feedstocks in an emissions trading program are discussed in more detail in the NRTEE Issue Paper, *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks* (January 1999).

97 This issue and a number of others related to credit creation are discussed in more detail in the NRTEE Issue Paper, *Possible Criteria for the Creation of Emission Reduction Credits Under a Domestic Emission Reduction Credit Trading Program* (January 1999).

98 These types of policies are mentioned here, but they are discussed in more detail in the NRTEE Issue Paper, *Policies That Could Complement a Domestic Emissions Trading Program for Greenhouse Gases* (January 1999).

99 A.P. Jaques et al., *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997.

100 The Center for Clean Air Policy, in its publication *US Carbon Emissions Trading: Some Options That Include Downstream Sources* (1998), raises another possibility. They suggest that automobile manufacturers could be held responsible for the emissions produced by the vehicles they sell and would therefore have an incentive to produce more carbon-efficient vehicles. The authors also note, however, that such a program would pose severe measurement challenges. Even if these measurement difficulties could be overcome, this program would clearly be inferior to requiring all individuals to hold allowances for their transportation fuel use. Under such a scenario, consumers would have an incentive to conserve fuel and to purchase fuel efficient vehicles. The proposal from the Centre for Clean Air Policy provides no clear incentive for consumers to conserve transportation fuels in any specific vehicle.

101 It should be noted that it would also be possible to make petroleum refiners responsible for the greenhouse gas emissions associated with the combustion of the heating fuels they sell that are combusted in residential and commercial buildings in Canada. This would increase the coverage of the program. However, members of the NRTEE Multistakeholder Expert Group concluded that sending a price signal in this manner was not a politically feasible way of addressing GHG emissions from a basic need like home heating and would raise concerns about unfair treatment of low-income households.

102 Alternatively, it would be possible to impose this requirement on marketers and distributors of transportation fuels in Canada. More research is required to identify the best point at which to apply the regulated requirement. Petroleum refiners have been chosen here simply because they are fewer in number and, being large energy users, they are already assumed to be participating in emissions trading.

103 Consumers can have a direct impact on emissions through their choice of vehicle, transportation mode and transportation fuel. In many important areas, however, even the impact of consumers is indirect. For example, it will only be through their influence on decision makers that consumers can help encourage changes in land use planning to favour public transportation.

104 More research is required to determine if greenhouse gas emissions from shipping can be included in the system. Greenhouse gas emissions from the combustion of transportation fuels in international shipping, like emissions from international air transport, are not part of Canada's Kyoto commitment. The simplest solution would be to make shippers responsible for their own emissions for transport within Canada, similar to the situation airlines face in the *Downstream Greenhouse Gas Emissions Allowance Trading with VCT* option. Addressing these emissions through petroleum refiners would impose price increases on shippers (as refiners increase prices in response to the limits they face), even though the emissions generated by shippers in international transport are not reflected in Canada's commitment. Under such a scenario, it may make sense to follow the example set by the treatment of fossil fuel feedstocks in the *Cap on the Carbon Content of Fossil Fuels and Other GHG Emissions* option and allow shippers to create emission reduction credits equivalent to the emissions associated with international transport that could then be sold to the petroleum refiners.

105 Canada produced 165 Mt of greenhouse gas emissions from transportation in 1995. The contribution from airlines (10.8 Mt) and railways (5.7 Mt) is already included in the preceding program. Greenhouse gas emissions from the marine (5.6 Mt) and other (2.4 Mt) have been excluded. As a result, this program adds 140.5 Mt to the trading program relative to the preceding program. No effort has been made to subtract alternative transportation fuels like natural gas from these emission totals, but these alternative fuels represent only a miniscule portion of Canada's total transportation fuel use.

106 As noted earlier, it would also be possible to address heating fuels for residential and commercial buildings that are produced by petroleum refineries under such a program. Doing so would increase coverage further.

107 According to conventional economic theory, petroleum refiners will not simply increase the price of fuels enough to cover the costs associated with the purchase of any additional allowances they may require. Instead, they are likely to increase the price of all fuel sold in a manner that reflects the marginal cost of purchasing one new allowance.

108 It is not likely that petroleum refiners would be able to cover the full cost of their allowances through increases in the price of their products, although they should be able to cover a significant portion of their cost. This is because they may not be able to pass on the full price increase. More study is needed on the ability to pass on cost increases through higher prices to consumers of transportation fuels. The more inelastic the demand for transportation fuels, the more likely it is that petroleum refiners will be able to pass on their increased costs.

109 There is a brief discussion of this issue in *US Carbon Emissions Trading: Some Options That Include Downstream Sources* (Center for Clean Air Policy, 1998). It should be noted that the price elasticity of gasoline is also likely to change over time.

110 This case also includes the possibility that the Kyoto Protocol comes into force but without ratification by Canada, so that Canada does not have a national commitment to limit greenhouse gas emissions. Although the options for a domestic greenhouse gas emissions trading system are the same if the Kyoto Protocol does not come into force or comes into force without Canadian participation, the economic analysis would probably be quite different.

111 This case also includes the possibility that Canada adopts a national commitment to limit greenhouse gas emissions but the Kyoto Protocol does not come into force. The options for a domestic greenhouse gas emissions trading system to meet the national commitment are basically the same regardless of whether the Kyoto Protocol comes into force, but the economic analysis of the two cases would be quite different.

112 The Kyoto Protocol sets out emission limitation commitments for 38 countries, including Canada, and the European Union. Canada's commitment is to limit average emissions for the period 2008-2012 to 94% of 1990 emissions.

113 Sources that begin to reduce their emissions before their future commitments are defined also run a risk that those commitments will not recognize the early action. The result could be more onerous commitments for sources that have implemented early reductions (and hence benefited the environment) than for sources that have increased their emissions in the interim (and hence damaged the environment). A credit for early action policy should correct such perverse incentives.

114 The "credit" could take a variety of forms including adjustment of the baseline for determining future commitments, financial incentives such as tax credits, credit toward potential commitments prior to 2008, and credit toward potential commitments during the 2008-2012 period. Obviously different forms of "credit" provide different levels of incentive for emissions reduction and trading prior to actual implementation of an emission limitation commitment.

115 The GERT, PERT and NESCAUM pilot projects have limited durations and the GERT project has provisions that can be used to limit the volume of trading.

116 A voluntary cap and trade program involving companies that have submitted voluntary emissions limits to the VCR would require more stringent emissions monitoring, reporting and verification than is required by the VCR.

117 The intent is to incorporate as many gases and sources into each design, except option 12, but some sources, such as methane emissions from livestock, probably will not lend themselves to inclusion in a trading system.

118 Details as to how these mechanisms will work remain to be agreed. The rules for international emissions trading can be agreed before the Kyoto Protocol comes into force. The rules for the other mechanisms can only be adopted formally after the Protocol has come into force, although discussion of what those rules should be is already under way. Knowledge of the detailed rules for the three mechanisms is not needed to analyze options for domestic emissions trading, only the assumption that an international market for greenhouse gas allowances and credits will exist in which Canadian sources will be able to participate.

119 Canada's commitment under the Kyoto Protocol covers the five years from 2008 through 2012. The caps for participants in a domestic emissions trading program could be for five years or for a shorter period, such as one year. This is one of the design features to be discussed in Issue Paper 8.

120 If credits for emissions reductions prior to 2008 can be used to meet commitments after 2008 owners of such credits could also use them to help achieve compliance.

121 Another possibility is to use strategic points in the distribution chain to administer the trading program, but to leave responsibility for compliance further upstream as in option 4 or 5. Thus, gas pipelines might be obligated to help administer the program by collecting allowances for the carbon content of the gas transported from the shipper. If responsibility for the carbon content was imposed at the wellhead as in option 4, allowances would need to be transferred with any change in ownership between the wellhead and the pipeline shipment.

122 The "targets" could be defined in terms of a "trajectory" with declining annual emissions over the 2008-2012 period. To ensure that

industry achieves its "target" and the national commitment is met, industry assurances could be supplemented by penalties for failure to achieve the target.

123 Again the "target" could take the form of a "trajectory" of annual emissions limits. To ensure that industry achieves its "target" and the national commitment is met, industry assurances could be supplemented by penalties for failure to achieve the target.

124 Again, the "cap" could take the form of a "trajectory" of annual caps.

125 PERT participants have agreed to retire 10% of the credits created to benefit the environment. Companies that create credits under PERT have been permitted to claim emissions reductions back to 1994.

126 During 1997, 15 credit creation protocols were reviewed by PERT. Only five had been listed on the registry as of June 1998. Reasons for not listing credits on the registry include plans to hold the credits for internal use, delays in securing senior management approval to proceed with registration, and waiting for the PERT letter of understanding to be officially signed by the Ontario Minister of the Environment. Only emissions reduction credits listed on the Clean Air Action Corporation registry are recognized by PERT.

127 Although not shown in the summary data in Table A2.1, NOx and VOC emission reductions achieved during the ozone season and non-ozone season are tracked separately.

128 Actions to reduce NOx or VOC emissions do not always reduce CO_2 emissions, however; sometimes they increase CO_2 emissions.

129 Alchemy Consulting Inc., Constable Associates Consulting Inc. and Margaree Consultants Inc., in association with BOVAR Environmental, *Requirements for a Pilot Greenhouse Gas Offsets Program in British Columbia: A Discussion Paper*, prepared for Environment Canada, B.C. Ministry of Employment and Investment, B.C. Ministry of Environment, Lands and Parks, Greater Vancouver Regional District, and Fraser Valley Regional District, March 1997.

130 See C. Rolfe, *Additionality: What Is It? Does It Matter?*, Report prepared for the Technical Committee of the Greenhouse Gas Emission Reduction Trading pilot, available from the pilot web site at <http://www.gert.org>.

131 The octane boost provided by lead declines exponentially as the lead content increases. Reducing the lead content from prevailing levels only reduced the octane rating a little. But adding the lead saved to gasoline with no lead provided most of the desired octane boost. Thus trading encouraged more efficient use of lead.

132 The lead content was limited to a maximum of 1.1 grams per gallon.

133 Note that the total quantity of lead was not constrained. The maximum lead content per gallon, combined with declining sales of leaded gasoline due to the decreasing number of vehicles using leaded gasoline, led to a reduction in lead emissions.

134 A "refiner" was anyone who manufactured gasoline; thus someone who added ethanol to leaded gasoline was deemed to make an amount of leaded gasoline equal to the amount of ethanol added.

135 In other words, the emissions standards for the other pollutants might not impose a binding constraint on manufacturers. In that case there would be no cost savings due to emissions trading, and the demand for credits would be zero.

136 Every engine must also have an emissions rate below the standard for each of the other regulated pollutants for that engine.

137 Averaging is more attractive because banked credits have been discounted by 20%, while credits used for averaging are not discounted.

138 The EPA has proposed to replace the existing HC and NOx standards with an NMHC + NOx standard, to revise the PM standard and to allow ABT for both. The EPA is also in the process of finalizing rules to implement emissions standards for non-road diesel engines of less than 50 hp beginning in 1999. Current proposals for those rules include ABT provisions for NMHC + NOx and PM.

139 This option, however, is not *exclusively* a substance trading program. Allowance trading for some greenhouse gas emissions and credit trading for some emissions and for carbon sequestered are also part of this option.

140 The Montreal Protocol has been amended and supplemented by several other agreements. These agreements and revisions are collectively referred to here as the Montreal Protocol. Consumption is defined as production + imports – exports.

141 There were only 17 producers of ozone-depleting substances (ODP) in the world when the Montreal Protocol went into effect.

142 The baseline year is 1986 for Groups I and II and 1989 for Groups III, IV and V.

143 From 1989 through 1991, allowances were denominated in ODP kilograms for Group I and Group II substances (the only substances regulated at the time), so an allowance could be used for production or consumption of any substance in the Group.

144 Elizabeth Cook, ed., *Ozone Protection in the United States: Elements of Success*, World Resources Institute, Washington, D.C., 1996, Figure 3, p. 5.

145 Ibid., Figure 1, p. 35.

146 Although the base year for methyl bromide consumption under the Protocol is 1991, the allowances were distributed on the basis of average use over the 1991-1993 period because use fluctuates a lot from year to year.

147 Users could become importers, but becoming a licensed importer of a toxic gas like methyl bromide may involve considerable effort.

148 The descriptions of the trading programs below are adapted from those appearing in: Chris Rolfe, *Turning Down the Heat — Emissions Trading and Canadian Implementation of the Kyoto Protocol* (Vancouver: West Coast Environmental Law Research Foundation, 1998), pp. 226-228.

149 Southern California Air Quality Management District, *RECLAIM Program Three Year Audit and Progress Report* (May 8, 1998).

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Canada Building, 344 Slater Street, Suite 200, Ottawa, Ontario, Canada K1R 7Y3
Tel.: (613) 992-7189 • Fax: (613) 992-7385 • E-mail: admin@nrtee-trnee.ca • Web: http://www.nrtee-trnee.ca

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